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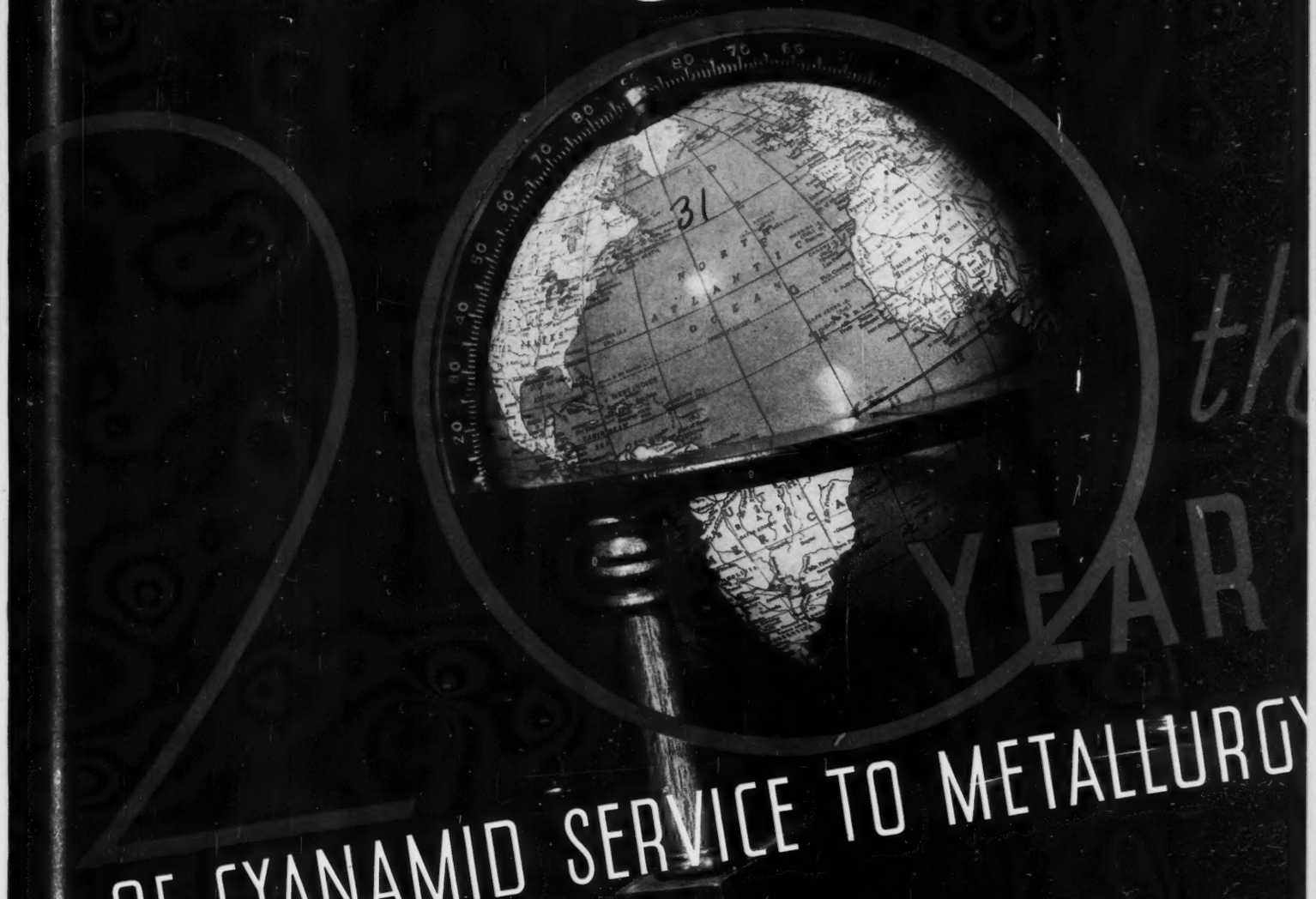

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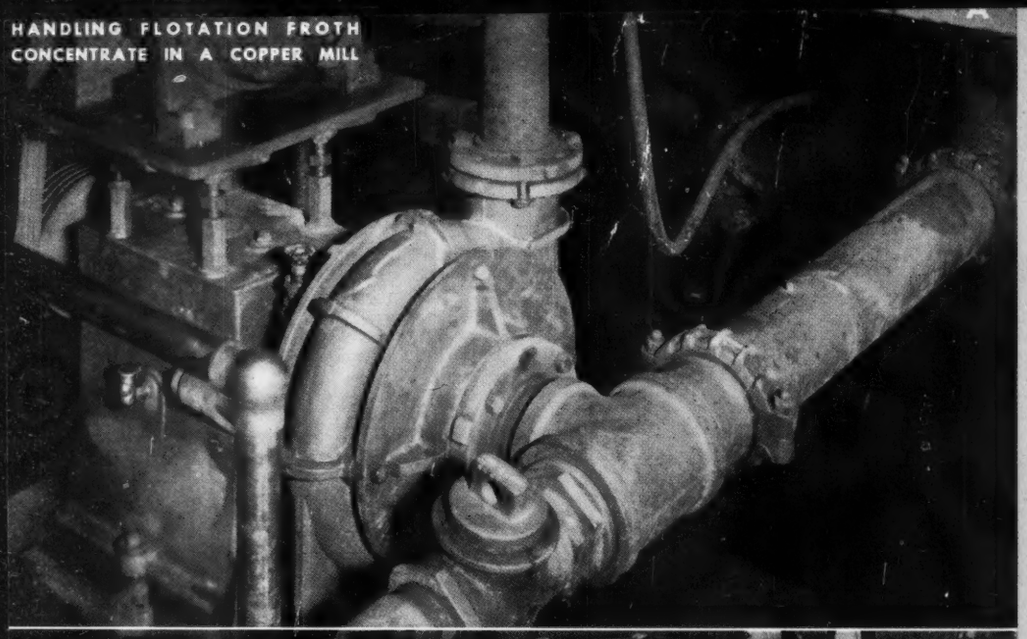

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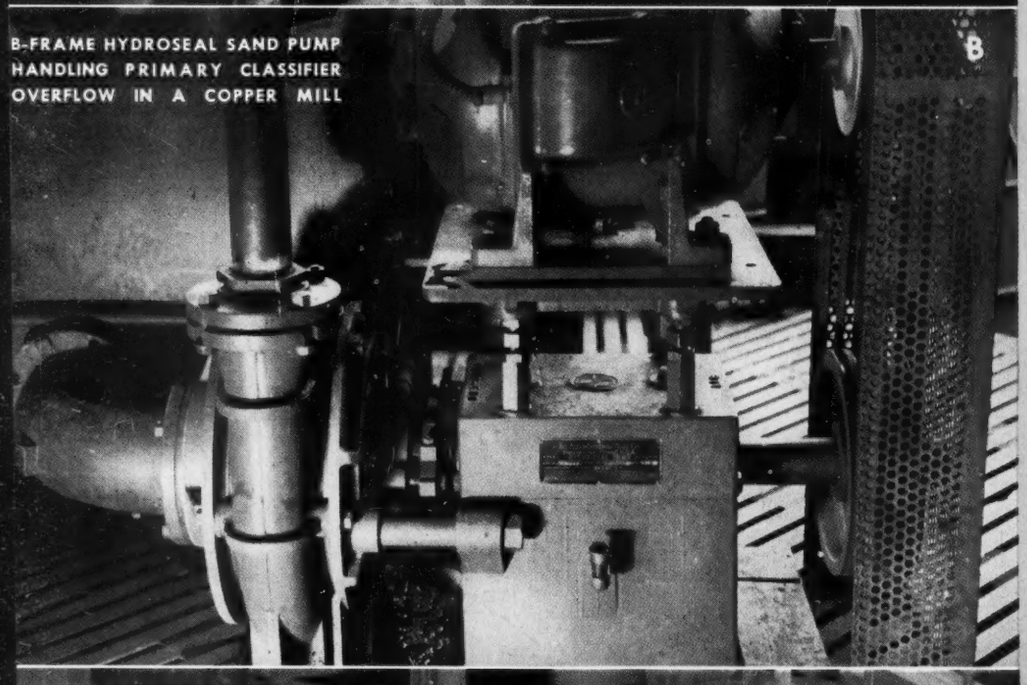

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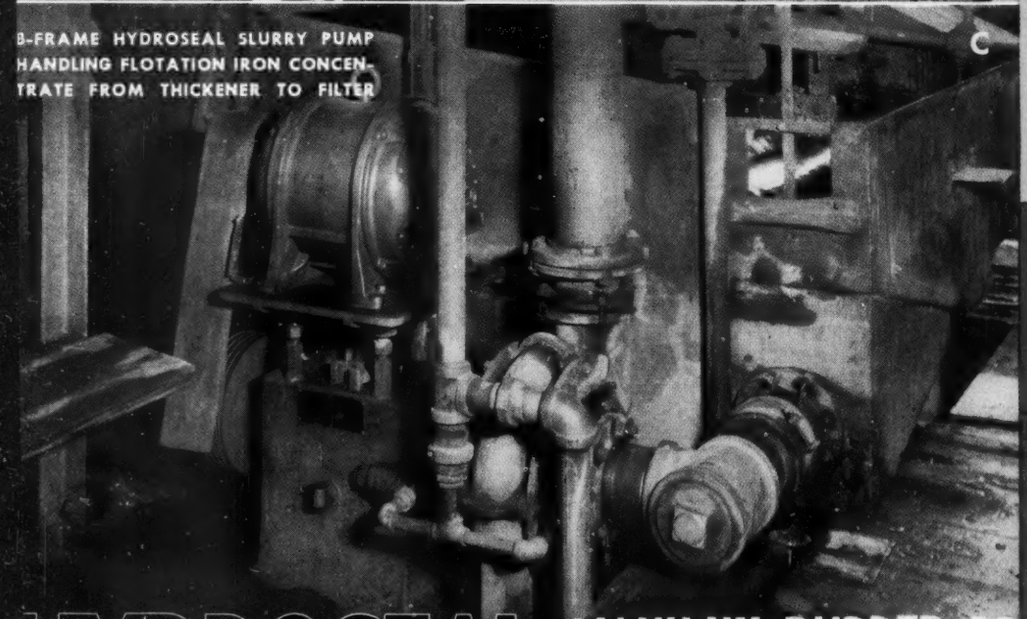

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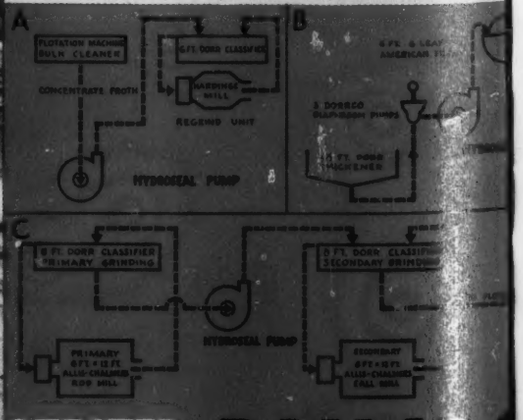

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Volume 139 FEBRUARY 1938 Number 2

Review and Outlook

1937 1938

ALTHOUGH 1937 closed on a sour economic note, it was, on the whole, a surprisingly good year in the metal-mining industry. Probably a greater tonnage of metallic ores and non-metallic minerals was extracted from the Earth than in any previous year. Preliminary estimates of world production of the major non-ferrous metals show that past records have been surpassed for all except lead. Average annual prices for copper, lead, zinc, and tin were higher than for any year since 1932, despite a steady decline from the March peak to the December low that dipped under the January opening level.

DETAILS will be found in authoritative economic reviews on the pages immediately following. We publish also as a supplement to this issue a graphical chart in color of *E. & M. J.* prices for copper, lead, zinc, tin, and silver since 1897, together with some statistical data on world production of those metals.

WORLD GOLD PRODUCTION in 1937 increased for the sixth consecutive year. All countries shared in the advance, with the Rand still in premier position. The U.S.S.R. remains an enigma, but thus far shows little evidence of making good her boast of overtaking the Rand. The price of gold continued unchanged at $35 per ounce. Rumors of a reduction in the United States price played havoc with commodity and share prices on the World's exchanges, but proved baseless and unwarranted.

SILVER PRODUCERS took full advantage of good and exceptionally steady prices to roll up a record production. At home they were stimulated by the prospective termination of the four-year agreement reached at the World Economic Conference in 1933. Abroad they were aided by the impetus given to silver buying under the United States Silver Purchase Act. The futility of the latter program, shown graphically on another page, lies in the fact that the United States plays fairy godmother to gold as well as to silver.

AMONG THE BASE METALS, copper in particular, difficulty was experienced in keeping production in step with consumptive demand. This finally resulted in accumulation of excessive stocks, in spite of curtailed production, and consequent softening of prices. Better control through more complete information is still a crying need in the interest of price stability. A promising effort might be made in this direction if an impartial agency were enabled to forecast prospective demand for metals, based on continuing surveys of manufacturing activity, mine production, and stocks of primary and secondary metals.

WHAT OF THE MINING OUTLOOK FOR 1938? The sustaining economic forces at home and abroad are the rising tide of armaments and the probable continuance of the price of gold at $35 per ounce. Steel and non-ferrous metals will be in increasing demand as the effects of the 1937 recession are corrected during the first half of 1938. Prices for the major non-ferrous metals probably will remain at low levels until rising industrial activity brings increased demand later in the year. Technical progress in mining and metallurgy will continue to be the main reliance of management in preserving the profit margin and meeting rising labor and commodity costs. The trend toward mechanization in loading and transporting ore underground and in open pits will receive new impetus. Increasing attention will be paid to the health and safety of miners, with particular emphasis on the prevention of silicosis. Political developments at home, and international conflict abroad, will inject elements of uncertainty that will puzzle management in the conduct of mining enterprises. On the whole, one cannot be pessimistic over the outlook, though it calls for courage and vigilance.

Silver

Prices steady in 1937

World output sets all-time high. Prospects for metal depend on U. S. Government action

New year has possibilities

Dickson H. Leavens

Cowles Commission for Research in Economics

THE YEAR 1937 set a record for steadiness in the price of silver. New York Official price varied between the narrow limits of 44⅜ and 46¼c. per fine ounce. This 2c. price range (which would be only 1c. if eight days in April were neglected) is the smallest recorded in that market since the price of silver was unpegged by the general abandonment of bimetallism which began about 1873. During the latter half of the year the price was unchanged at 44⅜c. The London range of 3 5/16d. between the April high of 21½d. and the December low of 18 3/16d. was greater, partly because of the fluctuations of dollar-sterling exchange and partly because the price weakened in December on account of the large supplies of silver coming from China and of the uncertainty as to the future of the American silver policy. As a result of the fall in the London price, Handy & Harman on Dec. 20 began to quote a separate price for silver for industrial uses, in contrast to the official price which represented foreign silver taken by the Treasury. This industrial price opened at 43½c., declined to 42c., and closed the year at 43⅜c. The price of 77.57+cents for newly mined American silver was maintained by the Treasury throughout the year.

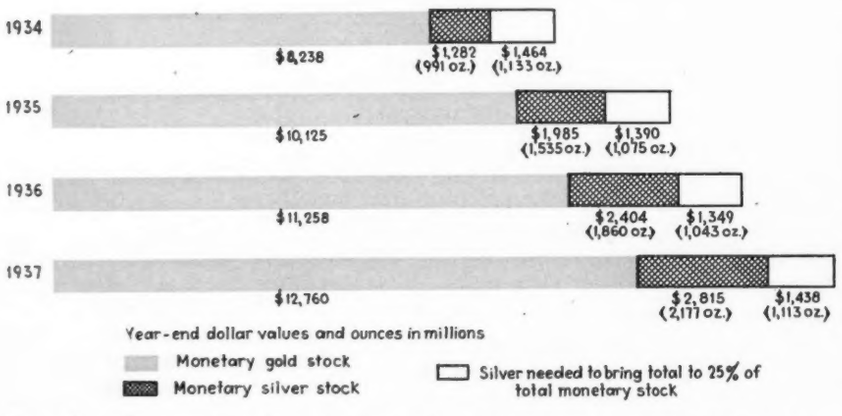
Production of silver increased to 276,000,000 fine ounces, surpassing the 1929 peak of 261,000,000 oz. and setting a new all-time high.

China has continued her managed currency system with no use of silver except in the reserves of Government banks. Over 250,000,000 oz. of the white metal was exported, chiefly to Hongkong, and thence to England, whence a considerable quantity has come to this country. Most of this movement took place in the autumn months. Some of this silver is merely being held in safekeeping for the account of the Chinese Government. The American Treasury has not announced how much Chinese silver it has purchased under the second silver agreement with China, signed July 12; under that agreement the Treasury may also loan money to China against the security of silver deposited here. In that way the silver may be kept off the world market without actual purchase. Handy & Harman estimate actual Chinese sales at 174,000,000 fine ounces and Chinese stocks held in London (including carry-over from 1936) at 200,000,000 fine ounces. It is to the advantage of the Chinese Government to work in cooperation with the American Treasury rather than to dump its holdings on the market more rapidly than the Treasury is willing to absorb them; for there is no other force to keep up the price. Chinese stocks, actual and potential, would be a distinctly bearish factor if American support were withdrawn. On Dec. 30 Secretary Morgenthau announced that the understanding with China had been renewed until July 1, 1938, but he gave no information as to the quantities and prices involved.

It is difficult to predict what effect the fighting in China will have upon the silver market. War may bring a depreciated paper currency and encourage the continued hoarding of the several hundred million ounces of monetary silver still distributed among the population. On the other hand, the pressure of need may bring out some of this silver into under-cover circulation, from which it may eventually reach the world market.

As in 1936, the Indian Government apparently has not sold any of its stock of silver derived from melted rupees, in spite of the quota of 35,000,000 fine ounces per year allowed by the London Agreement. That Government holds about 125,000,000 fine ounces and is no longer under any restriction as to its sale. It is not likely, however, to dump its stocks and so depress the price. Like China's, India's best course is to endeavor to unload on the American Treasury at the present price, even if it takes time.

The Indian people continued to absorb silver for the ornament trade during the first two months of 1937 even faster than in the record year 1936, when 100,000,000 fine ounces was imported. Since then imports have declined, the total for the year being less than 60,000,000 fine ounces. The import duty was raised to the equivalent of 7c. per ounce at the end of February, making the price about 5 per cent higher. This increase is hardly sufficient to account for the falling off in demand, which is probably because the large imports of 1936 represented to some extent the satisfaction of accumulated needs and because the buying power of the Indian



In spite of heavy buying of silver since the signing of the Silver Purchase Act, June 19, 1934, the Treasury has always been about one billion ounces short of maintaining one-fourth the value of its monetary stock in silver. The steady inflow of gold has kept the goal uniformly distant year after year

peasant has been reduced by the falling prices of his products, especially cotton. It would seem that, given reasonable prices for their agricultural products and the present price of silver, which is almost as low as it has ever been in terms of rupees, the Indian people might continue to absorb between 50,000,000 and 75,000,000 fine ounces of the white metal per year.

Mexico and Canada have continued to dispose of considerable portions of their newly mined silver to the American Treasury under agreements, at about 45c. per ounce. At the end of the year Secretary Morgenthau announced that these agreements had been extended through January, 1938, and stated that they were on a month-to-month basis. Since then the Mexican Finance Minister has made an announcement implying that the American Treasury will take 5,000,000 oz. a month of Mexico's new production, and, in addition, some 35,000,000 oz. representing the quantity acquired by the Mexican Government from its 1934-1937 production under the terms of the London Agreement.

The United States Treasury acquired during the year 1937 something over 300,000,000 fine ounces, or slightly less than in 1936. Of this about 70,000,000 oz. was newly mined American silver, and the remainder was bought under the agreements with China, Canada, and Mexico, or in the open market. The total stock of silver in the Treasury and in circulation at the end of 1937 was over 2,150,000,000 fine ounces. Only about two-thirds of this is actually in the monetary system, the remainder being bullion held at cost in the General Fund; this latter could, however, be transferred to the silver certificate reserve at any time. Silver still to be acquired under the Silver Purchase Act of 1934 is over 800,000,000 fine ounces if figured as one-quarter of the total gold and silver (implying that gold would be disposed of to obtain silver), or over 1,100,000,000 fine ounces if figured as one-third of the gold (implying that no gold would be disposed of). Both computations include the silver in the General Fund and the Inactive gold, which are potentially, though not actually, in the monetary system. The quota in 1934 was 1,000,000,000 or 1,300,000,000 fine ounces, depending on which way it was figured. Thus very little progress has been made toward the goal set up in that Act, in spite of the fact that 1,500,000,000 fine ounces have been acquired. The increase in gold has almost kept pace with silver purchases.

According to the estimates of Handy & Harman, about 14,000,000 oz. of demonetized silver came on the market during 1937 and about twice that quantity went into coinage in various countries. It is hardly to be expected that net coinage demand will again be a factor of much importance in the silver market, although it may account for few million ounces per year.

World demand for use in the arts and industries has increased to over 50,000,000 oz., and may be expected to hold its own or increase slightly, although it is subject to fluctuations with the business cycle which affects the demand for the part going into luxury uses.

On Dec. 31 the London Silver Agreement expired, and there is no thought of renewal, for compared with the Silver Purchase Act of 1934 it has been of minor importance. Under that act the American Treasury has such great powers to influence the price of silver and to take supplies off the market that it would be of little ad-

(*Continued on page* 40)

WORLD'S SILVER PRODUCTION . . . In Fine Ounces

Country	1934	1935	1936	1937
United States	26,441,000	38,322,000	62,842,000	70,500,000
Canada	16,415,282	16,618,558	18,231,419	22,600,000
Mexico	74,143,301	75,587,447	77,462,114	88,000,000
Peru	10,381,397	17,104,300	19,000,000	17,000,000
Other America	11,203,776	14,172,670	17,521,350	18,000,000
Europe	15,822,365	17,526,025	18,138,680	19,250,000
Australasia	11,284,396	12,412,979	13,730,547	13,950,000
Japan	6,882,011	8,153,507	9,587,000	9,900,000
India	6,850,000	6,860,000	6,670,000	6,900,000
Other Asia	2,292,481	2,436,699	2,815,000	3,000,000
Africa	4,663,241	5,173,155	4,819,847	6,250,000
Totals	186,379,250	214,367,340	250,817,957	275,350,000

Production statistics refer to new silver. Figures for 1934, 1935, and 1936 are by the American Bureau of Metal Statistics; 1937 estimated by *E&MJ*.

Gold

World output once again makes new record. Rising demand abroad causes increase in private hoarding

H. N. Lawrie

Consulting Economist [1]
Washington, D. C.

THE sixth consecutive record world's gold production was established in 1937, amounting to 37,285,995 fine ounces, as compared with 34,973,709 fine ounces in 1936, an increase of 2,312,286 fine ounces, or 6.6 per cent. The rate of increase is less than the rate of increase recorded in 1936, due largely to a decline in the tempo of the Soviet plan. The increase in 1937 may be attributed in large measure to new discoveries and greater milling capacity.

Notwithstanding the lower rate of increase, the 1937 production is large enough to supply the demands of the arts and trades and also to contribute more than the 3.2 per cent annual increase in the world's monetary gold reserves, which is considered necessary in meeting the world's monetary and financial requirements. Recovery from previous major economic crises has invariably been accompanied by a rising gold production, increasing the basis of credit with which to finance an ever-expanding industry and trade. The fact that the highest gold production in history was recorded in 1937 and that a further increase may be expected in 1938 is an indication that, despite the current recession in this country, the general course of world economic recovery, including that of the United States, is progressing, probably on a sounder and more permanent foundation.

The principal increases in gold production in 1937 were, according to Table I, as follows: Russia and Siberia, 500,000 oz.; United States, including the Philippines and Puerto Rico, 434,703 oz.; Transvaal, 404,677 oz.; Canada, 306,771 oz.; and Oceania, 176,653 oz. Declines were few and nominal. The Transvaal, U.S.S.R., and Canada established new records.

[1] Formerly Economic Adviser to the United States Senate Commission of Gold and Silver Inquiry and author since 1928 of the Chapter on Gold and Silver in "The Mineral Industry."

The U. S. S. R. plan, as announced in the Soviet press, provides for an output of gold in 1939 of 10,000,000 oz., but recent reports indicate that the tempo of the plan declined in 1937, with an increase in output over 1936 of only about 7 per cent, whereas the plan required more than double this amount to be mined. It is unfortunate that no official data on the production of gold in the U. S. S. R. has been made available in recent years. However, I have analyzed a large number of reports on operating conditions submitted to me through official and other sources and I believe that the 1936 and 1937 data given in Table I may be considered reasonably conservative.

Production of gold in the United States, including the Philippines and Puerto Rico, in 1937 amounted to 4,792,097 oz., an increase of 434,703 oz., or 10 per cent. This nearly equals the record production in 1915 of 4,887,604 oz. Again the rate of increase for the United States exceeds that of the world rate for 1937 over that of 1936, which indicates that this country is making a relatively higher contribution to the world's increase in 1937. This is due largely to the oppressive taxation and other regulations existing in some of the principal gold-producing countries, which have artificially restricted their outputs. The most important increases in 1937, as set forth in Table II, are as follows: Philippine Islands, 106,314 oz.; California, 104,697 oz.; Alaska, 97,923 oz.; Utah, 96,020 oz.; and Arizona, 33,183 oz. South Dakota in 1936 was second only to California, but due to a decline in the former in 1937 and the large increase in the Territory, Alaska moved to second place in 1937. California still maintains first position in the list of producers.

The net inflow of gold into the United States in 1936 amounted to $1,116,583,891. In 1937 it was $1,585,503,000, an increase of $468,919,109, or 42 per cent. The world movement of gold has never been more eccentric. Further disequilibrium in the distribution of the metal occurred in 1937. The groundless rumor in London that the United States expected soon to reduce the price to $30, or even to $25, per ounce resulted in heavy sales from privately hoarded stocks and large quantities continued to flow into the United States. In the spring when this heavy movement was in progress erroneous statements were made to the effect that the United States was the sole buyer and that the entire world was dumping gold in this country. The fact is that the British Exchange Equalization Fund was increased between March 31 and Sept. 30, 1937, from $933,590,000 to $1,394,890,000, or by nearly 52 per cent; and gold in this fund is entirely independent of gold held by the Bank of England.

As the recession in economic recovery continues, the demand for gold increases and large hoards of privately-owned gold are reported to be accumulating in London and other European centers. In this country, the Treasury released to the gold reserves of the Federal Reserve System $300,000,000 from the Inactive Gold Account on Sept. 13, 1937, to insure, it was reported, the maintenance of an easy money market. On Dec. 31, 1937, this Account amounted to $1,277,696,322.52, so that there is ample gold available still further to release in the event it should become necessary to prevent the tightening of the money market. For the same purpose the Federal Reserve gold reserve which was elevated to 100 per cent

(*Continued on page* 46)

Table I—World Gold Production

In Fine Ounces

	(a)1936	(a)1937
North America		
United States	3,759,645	*4,088,500
Canada	3,748,028	4,054,799
Mexico	753,967	842,160
Newfoundland	15,070	15,000
Puerto Rico	483	*17
Totals	8,277,193	9,000,476
Central America	78,502	83,000
South America	1,184,668	1,287,000
Europe		
Russia, including Siberia	(b)7,289,000	(b)7,789,000
Other Europe	519,896	580,000
Totals	7,808,896	8,369,000
Asia		
British India	331,389	*352,548
East Indies	68,083	68,000
Japan and Korea	1,207,638	1,200,000
Philippines	597,266	*703,580
China and Others	292,249	290,000
Totals	2,496,625	2,614,128
Oceania		
Australia	1,163,661	1,298,500
Fiji	16,943	19,000
Tasmania	17,600	17,000
New Guinea	360,670	375,000
Papua	31,398	30,000
New Zealand	164,575	192,000
Totals	1,754,847	1,931,500
Africa		
Transvaal	11,336,214	*11,740,891
Rhodesias	801,513	814,000
West Africa	527,104	607,000
Congo, Egypt, etc.	708,147	839,000
Totals	13,372,978	14,000,891
Totals for world	34,973,709	37,285,995
Total value in 1936 ($35=1 oz.)	$1,224,079,815	
Total value in 1937 ($35=1 oz.)	$1,305,009,825	

* Indicates data based on twelve months' returns.
(a) Data for 1936 revised to date and preliminary estimates for 1937 based largely on eleven months' returns by H. N. Lawrie.
(b) Estimates by H. N. Lawrie based on unofficial returns and reports on operating conditions.

Table II—Production of Gold In the United States

In Fine Ounces

	1936*	1937*
Alaska	517,311	615,234
Alabama	4,780	2,483
Arizona	318,126	351,309
California	1,048,606	1,153,303
Colorado	372,943	372,574
Georgia	454	500
Idaho	85,311	78,000
Maryland	631	994
Michigan	.....	52
Montana	185,383	200,255
Nevada	286,834	273,031
New Mexico	35,966	41,668
North Carolina	1,940	1,008
Oregon	61,940	52,294
Pennsylvania	1,051	1,834
South Carolina	274	1,846
South Dakota	589,286	575,746
Tennessee	366	115
Texas	620	534
Utah	233,260	329,280
Virginia	914	1,054
Washington	11,646	33,574
Wyoming	2,003	1,812
Totals	3,759,645	4,088,500
Philippine Islands	597,266	703,580
Puerto Rico	483	17
Totals	4,357,394	4,792,097
Value (a)	$152,508,800	$167,723,400
Record Year 1915		4,887,604
Value (b) 1915		$101,035,700

* 1936 data revised and preliminary data for 1937 supplied by the U. S. Bureau of the Mint, with the cooperation of the U. S. Bureau of Mines, and compiled by H. N. Lawrie.
(a) Value on the basis of $35 per fine ounce of gold.
(b) Value on the basis of $20.6718 per fine ounce of gold.

Copper

Disappointment marks year for industry, thanks to miscalculations of producers and to speculation

W. R. Ingalls

Director
American Bureau of Metal Statistics

THE PRICE FOR COPPER in 1937 opened at 12c. On March 31, after five advances, it peaked at 17c., but that prevailed for only a few days and on April 6 it was reduced to 16c., following which in three step-downs it settled at 14c., which prevailed until near the end of September. In the absence of any substantial demand after that time the price crumbled away to 10⅛c. This is a curt record of the market in a year of illusion and miscalculation, in respect of which producers were not so much to be blamed as were reckless speculators and frightened consumers.

When the advance in the market began in the last quarter of 1936 producers did not dream that it could go so far as it did, and some of the American producers sold their entire expected production in the first half of 1937. Speculation focused in London, with the natural reactions here, and was built upon fallacious ideas of military requirements and upon anticipation of inflationary conditions. The bubble burst of its own distention, following which conditions became more or less stable until toward the fourth quarter, when it became evident that in the United States we were facing a general economic depression. The depression seems to be peculiar to the United States, but the copper market in London has had to follow New York, just as on the bull movement New York had to follow London.

Early in January, 1937, all restriction upon production among foreign producers was suspended. Production ex U. S. A. then rose with surprising rapidity to a rate of 148,000 per month. This would have put things out of balance pretty soon had it not been for an equally surprising increase in the rate of foreign consumption, which declined a little during the second half of the year, but nevertheless was maintained at a high rate. Even so, it became evident soon after the middle of the year that production was running too heavily, and on Oct. 1 the international conference among the major producers, who afford about 75 per cent of the output ex U. S. A., announced that their output was to be curtailed, effective Dec. 1, to the rate last in effect (105 per cent of basic capacity) which had been adopted Nov. 5, 1936.

In speaking of foreign consumption we mean deliveries, rather than true consumption, as to which we have scarcely any information. Copper in preparation for consumption passes through complex manufacturing stages; and as true consumption increases there has to be not only a corresponding increase in shipments ex mills, but also an additional increase in what they have in process; i.e., in invisible inventory. When the

(*Continued on page* 46)

WORLD'S COPPER PRODUCTION . . . In Short Tons

Country	1934	1935	1936	1937
United States	240,099	380,100	614,971	820,000
Canada	183,415	308,224	205,191	265,000
Mexico	52,116	45,880	35,960	53,000
Chile	282,965	294,404	282,237	425,000
Peru	30,572	32,687	36,241	38,000
Germany	26,455	27,558	27,558	28,000
Russia	48,587	69,717	91,491	100,000
Spain and Portugal	38,347	34,858	30,615	32,000
Japan	73,856	76,507	86,672	95,000
Africa	290,682	295,638	272,229	410,000
Elsewhere	128,731	143,284	155,139	168,000
Totals...	1,395,825	1,608,857	1,838,304	2,434,000

So far as possible, these statistics are based on blister copper, referred to countries wherein ore originated. In other words, new copper. Figures for 1934, 1935, and 1936 by American Bureau of Metal Statistics; 1937, *E&MJ* estimate.

Lead

Market enjoys respite from the hard times of the depression. Statistical position at year's end is good

F. E. Wormser

Secretary
Lead Industries Association

DURING 1937 the course of the lead market was extraordinary. Unusually wide movements, such as a decline of 1c. per pound in a day, were conspicuous. For a parallel one has to go back to 1917 and 1918, when war influences were at work.

The year began with the price advancing strongly under the influence of a rising world market, which carried the American price from 6.00c. on Jan. 1 to 7.75c. New York on March 10. On many days the London price was sufficiently higher than New York to make shipments abroad profitable. However, lead was in such strong demand for domestic requirements that no tonnage of consequence was exported. In addition to a speculative fervor in London, the price abroad responded to a consuming demand based upon armament programs and a continuing business recovery. Moreover, there was a shortage in the usual Spanish supply of lead.

When the turn took place, in the middle of March, the New York lead price slumped by stages to 7.00c. On April 7, a cut of a full cent per pound was made in the St. Louis market and the New York price was brought back to 6.00c. After this the price remained steady at 6.00c. until early August, when demand grew sufficiently to move it back to 6.50c. From then on, however, the price declined and finished the year at 4.75c. The average for the year of 6.01c. compares with 4.71c. New York for 1936, a decided improvement. In fact, 1937 was the best year the industry has had since 1929.

Strong demand for lead over most of the year caused the mines in Missouri to operate at near capacity, and the silver-lead properties in Idaho and Utah to run at capacity in many cases. Demand exceeding supply, the large stocks which had been hanging

over the market for three years were rapidly depleted. At the beginning of the year refined pig lead stocks in hands of sellers amounted to 165,000 tons, in August roughly half that amount, and at the year's end about 125,000 tons.

In appraising the significance of pig-lead stock statistics, it is well to remember that they include metal in sellers' hands which has already been paid for by consumers and is no longer available for purchase. The increase since October is due to the great decline in volume of sales by producers and to their inability to curtail operations immediately. Moreover, lead production in the West was maintained at a comparatively high rate during the latter part of the year, to take advantage of the Government's domestic silver price of 77.57c. per ounce, particularly as there was uncertainty as to the continuance of that fixed price. Nevertheless, the lead market enters 1938 in the best statistical position since the depression began.

Production of refined lead from domestic ores and concentrates at smelters was probably close to 492,000 tons in 1937, compared with 432,000 in 1936 and 377,000 in 1935, according to estimates based upon American Bureau of Metal Statistics figures. When one considers that production of lead from mines in the United States for the years 1931 to 1936, inclusive, averaged 334,000 tons, the improvement in 1937 is striking. The volume, however, is still below that of the period from 1923 to 1930 inclusive, when mine production averaged 645,000 tons. These data include antimonial as well as soft lead. It is problematical whether production in the future will equal the record of the late 20's. Some of the larger mines could increase their output but are faced with the question whether expansion in production facilities is justified. No new lead discoveries of importance have been made in the United States in recent years. The price of lead, however, has been so low, except in 1937, that intensive exploration was hardly justified.

An increase of about 15 per cent in world production of lead in 1937 is indicated. Spain continues absent as a substantial producer. Canada is estimated to have produced over 200,000 tons of lead in 1937 for the first time in history. It continues to have the largest lead-producing mine in the world.

Shipments of lead for domestic consumption will probably total about 575,000 tons for 1937, compared with 513,000 in 1936, an estimate based upon A.B.M.S. data. These figures include lead derived from foreign ores and scrap. This is an increase of about 12 per cent in volume. Perhaps the most significant trend in consumption was the reappearance of substantial demand from cable manufacturers, who are estimated to have taken over 90,000 tons of lead, compared with 61,000 in 1936 and 39,000 in 1935.

Consumption of pig lead in the manufacture of pigments continues the most important outlet. Whereas demand for white lead declined in 1937, the use of litharge remained steady. Domestic production of white lead will probably come close to 110,000 tons in 1937, compared with 125,000 tons in 1936. Litharge production will probably amount to 85,000 tons, the same as for 1936. Demand for litharge may be expected to be maintained, unless further inroads are made by black oxide, a lead pigment made by fine-grinding of pig lead, which in recent years has displaced large quantities of litharge. About 40,000 tons of black oxide is produced annually.

The battery industry also supplies the bulk of the secondary lead recovered annually. During 1937 receipts of old plates and parts were higher than in 1936 by roughly 10 per cent. Reclamation of secondary lead remains an important factor in the market. In times of great activity, as during 1937, the influence of scrap is not so great as in times of depression. In 1937 roughly 3 tons of ore was mined for every ton of lead reclaimed from battery plates, whereas a few years ago the ratio was ton for ton.

The amount of lead going to the ammunition industry increased in 1937, but this outlet remains one of the smaller avenues of consumption. On the other hand, the use of lead in foil decreased sharply, a result of the relatively high price of lead last spring. Lead so used has to meet intensive competition from other metals and non-metallic materials. Use of lead in plumbing seems to be increasing.

WORLD'S LEAD PRODUCTION . . . In Short Tons

Country	1934	1935	1936	1937
United States	330,911	371,212	400,009	497,000
Canada	159,833	165,357	184,659	200,000
Mexico	193,547	204,172	240,670	247,000
Germany	132,276	134,811	153,330	182,000
Belgium	73,468	73,821	76,279	85,000
Italy	46,241	39,870	44,092	45,000
Spain	82,516	78,068	51,344	(a)
Russia	29,985	40,565	55,997	60,000
Australia	226,336	243,046	221,121	250,000
Burma	80,437	80,707	81,936	87,000
Elsewhere	136,595	125,838	128,766	240,000
Totals	1,492,145	1,563,860	1,646,154	1,893,000

In general, the statistics cover production in terms of bullion, allocated according to origin of ore. Figures for 1934, 1935, and 1936 by American Bureau of Metal Statistics; 1937, *E&MJ* estimate.

Silver

(*Continued from page* 37)

vantage to the signers of the original agreement to attempt any further arrangement.

On Dec. 31 also the President extended his original Silver Purchase Proclamation of Dec. 21, 1934, for another year or until further notice, but increased the seigniorage charge from 40 per cent, as set on April 24, 1935, to 50 per cent, as in the original proclamation. This makes the effective price for newly mined American silver again 64.64+ cents per fine ounce, compared with the 77.57+ cent figure at which it has stood for nearly three years.

As in the last few years the prospects for silver depend entirely upon American Government action. Only about half of world production of 275,000,000 oz. can be absorbed by the normal demands for industrial uses, for the Indian ornament trade, and for miscellaneous coinage. There is no natural market for the other half of new production plus the stocks of over 300,000,000 oz. held by the Chinese and Indian governments. The world silver industry cannot expect to depend upon American aid in perpetuity; an adjustment of price to demand must be made some day. The Government has made a start by decreasing the price for newly mined American silver; it would seem logical to go further and begin to decrease gradually the price paid for foreign silver, for it is hard to see any valid reason for subsidizing foreign producers and holders indefinitely. The Treasury has intimated that it is on a "twenty-four hour policy" with regard to silver, and it is possible that 1938 may see further developments.

Zinc

Metal scarcity, acute by August, relieved by decline in market. Imports moderate for the year

Marshall L. Havey

General Sales Manager
New Jersey Zinc Company

FOR THE FIRST nine months of 1937 the slab-zinc market presented an interesting statistical picture. This picture might seem to make little sense until all contributing factors are carefully analyzed to determine the influence each exerted. Let us glance at some figures of the American Zinc Institute. At the start of the year the stock of metal was less than 45,000 tons—no more than adequate, as it represented less than three weeks' supply based on consumption at that time. Also, it was a reduction of 35,000 tons from stocks a year earlier, despite the production in that year of 524,000 tons, which was exceeded only in 1925, '26, '27, '28, and '29. But it was a pleasant contrast to the 145,000 ton maximum recorded early in 1931, which at the 1931 rate of consumption approximated six months' supply. And with this stock of a little less than 45,000 tons on Jan. 1, 1937, the price of Prime Western slab zinc, East St. Louis, was 5.54c. against a 1931 average price of 3.64 with 140,000 tons of metal on hand, and a 1932 average of 2.88c. (including an all-time low of 2.30c.).

As is now recognized, the speculation in commodities—tending to create price and inventory maladjustments in many fields—was under way late in 1936, and before 1937 had fairly started the British Rearmament Program with its attendant emphasis on metal speculation helped to send world prices of all metals upward. And with them zinc went to 7.50c. by March 8, although it might be said to be a sympathetic action, inasmuch as little or no United States zinc went abroad to fill foreign requirements.

Meanwhile, business conditions in this country continuing good, consumption proceeded steadily at upwards of 12,000 tons per week, while production at some points was meeting difficulties. Along with the prices of all other commodities, that of zinc declined in early April to 6.75c., where it stayed for three months in the face of dwindling supplies. The acuteness of the situation in August (less than a week's supply was available) caused higher quotations. Referring to an able summary of the situation of the moment, appearing last September in *E.&M.J.*, we read:

"A series of unpredictable circumstances brought about a shortage in the domestic supply of the metal. Production of zinc in the country might have been fully 60,000 tons larger in the first half of the year but for the drought in the Northwest, which curtailed power supply at the electrolytic plants of Anaconda; labor difficulties in other sections of the country; and uncertainties surrounding the foreign market. Plans to increase production of the common grades progressed slowly, due, in some

(*Continued on page* 47)

WORLD'S ZINC PRODUCTION . . . In Short Tons

Country	1934	1935	1936	1937
United States	366,933	431,499	523,166	589,932
Canada	134,926	149,103	151,697	168,000
Mexico	40,354	44,084	35,506	34,000
Belgium	192,792	200,332	217,908	257,000
France	56,410	56,729	59,084	66,000
Germany	80,358	136,906	150,354	179,000
Great Britain	57,344	67,717	68,086	72,000
Poland	102,522	93,688	105,197	112,000
Australia	59,880	74,856	77,778	84,000
Russia	29,929	50,922	72,752	88,000
Elsewhere	183,604	180,769	188,694	195,068
Totals...	1,305,052	1,486,605	1,650,222	1,845,000

Production of zinc by primary metallurgical works. Figures for 1934, 1935, and 1936 are by American Bureau of Metal Statistics; 1937, *E&MJ* estimate.

Tin

Production a record. Stocks low, the visible tonnage increasing slightly. Price level high but unstable

E. Baliol Scott

Editor "The Mining Journal," London, England

THE FIRST YEAR of the new International Agreement (1937) proved very favorable for the tin industry. Already geared up to 105 per cent of standard tonnages in the fourth quarter of 1936, it needed no preliminary effort to reach full authorized output, and as the quota for the whole year averaged 107½ per cent, failure to achieve a world record would have been strange.

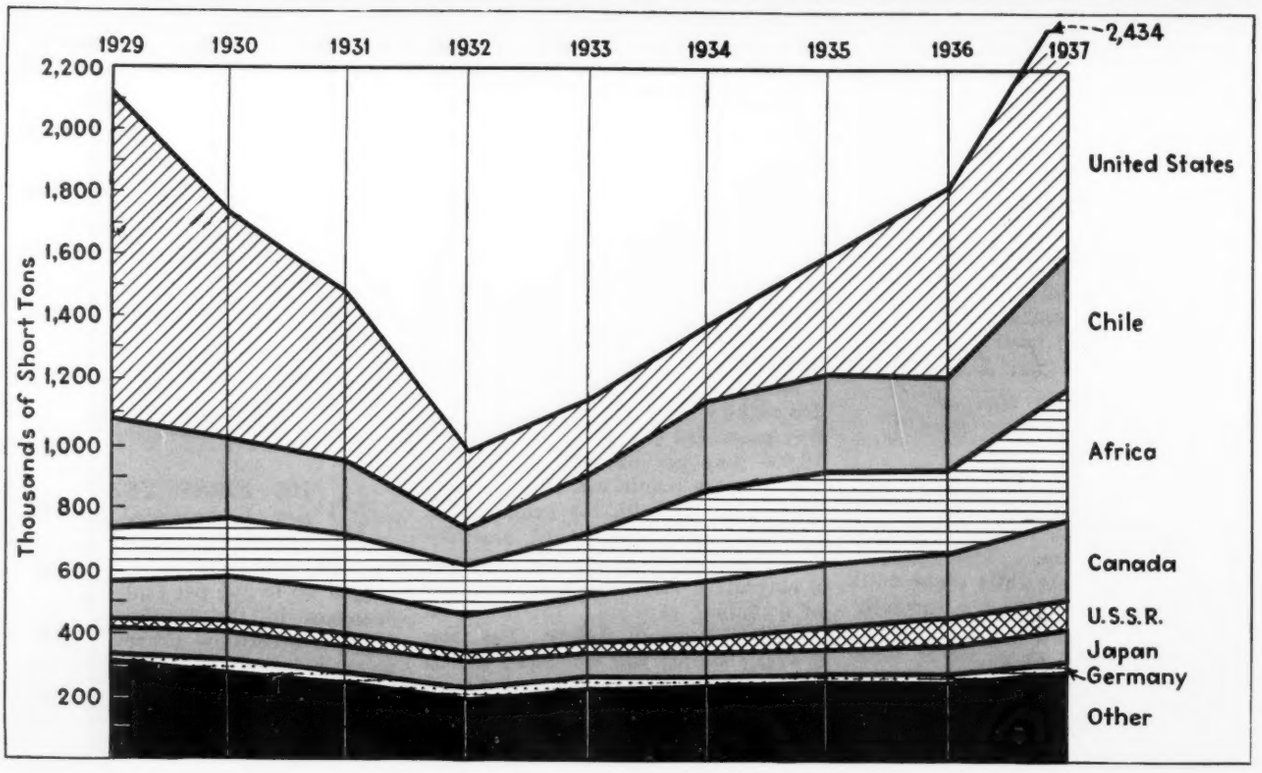
The industry was no less favored by consumptive demand, especially in the United States, where deliveries were 83,665 tons—9,660 tons higher than in 1936, and surpassed only in 1929, when they showed a substantial surplus over consumption. Although too early yet for verified production figures, the Control estimate is that total output was 200,000 long tons, compared with a total of 179,399 tons for 1936.

Malaya realized her quota of 77,334 tons without difficulty. Netherlands Indies, with a quota of 39,055 tons, and Nigeria, with 11,707 tons, are believed to have done so with effort. Siam made a big advance on any previous return and is understood to have just exceeded 17,000 tons—about 3,000 tons short of 107½ per cent quota. Bolivia exported about 25,000 tons, against an enlarged quota of just under 50,000 tons. The Congo will probably export about 8,000 tons of her 11,600 ton quota, though producing more. Indo-China with a 3,000-ton standard seems unable to do more than about half.

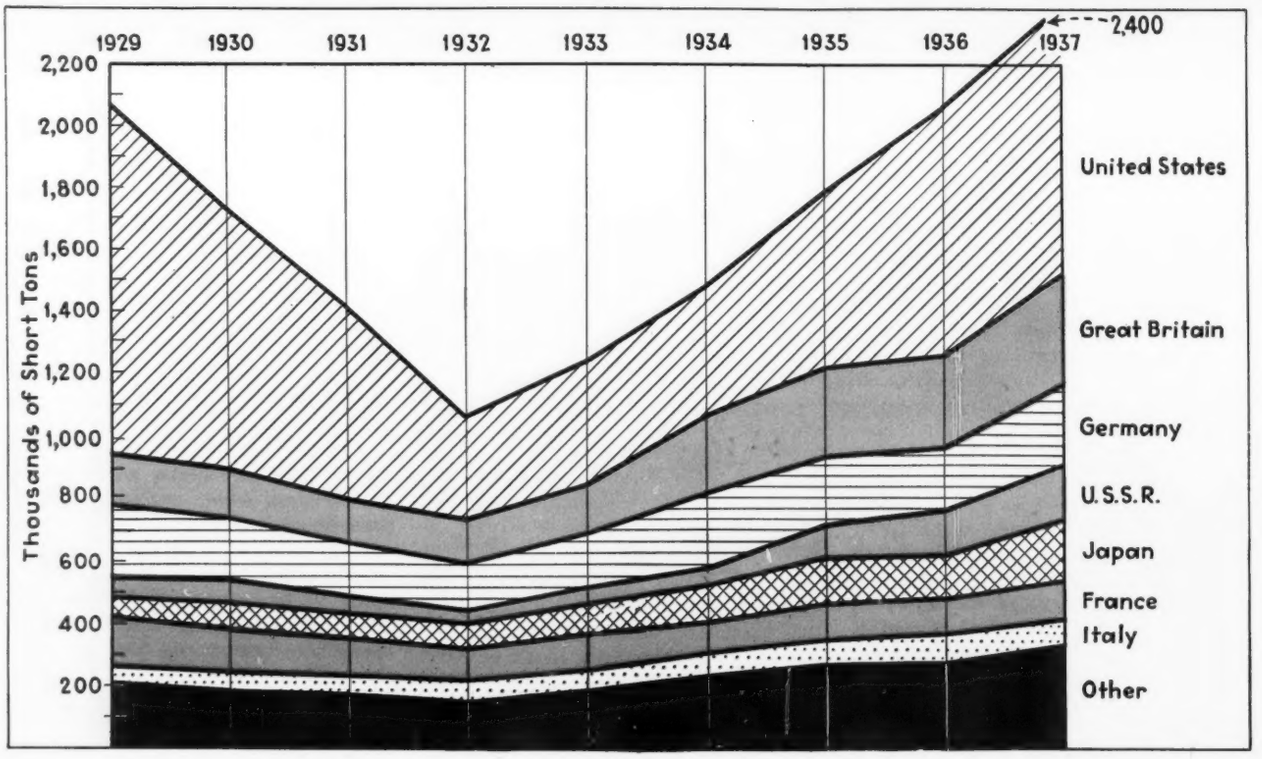
If the tonnage allocations are to prove reasonable, it will be seen how much world production capacity has increased since 1929. Even Bolivia, the greatest laggard, does not seem short of ore reserves, only of labor and other revenue resources than tin, and nowhere perhaps was more development of ore in the ground done last year. The plans for operation in 1938

(*Continued on page* 47)

Trend in World COPPER Production

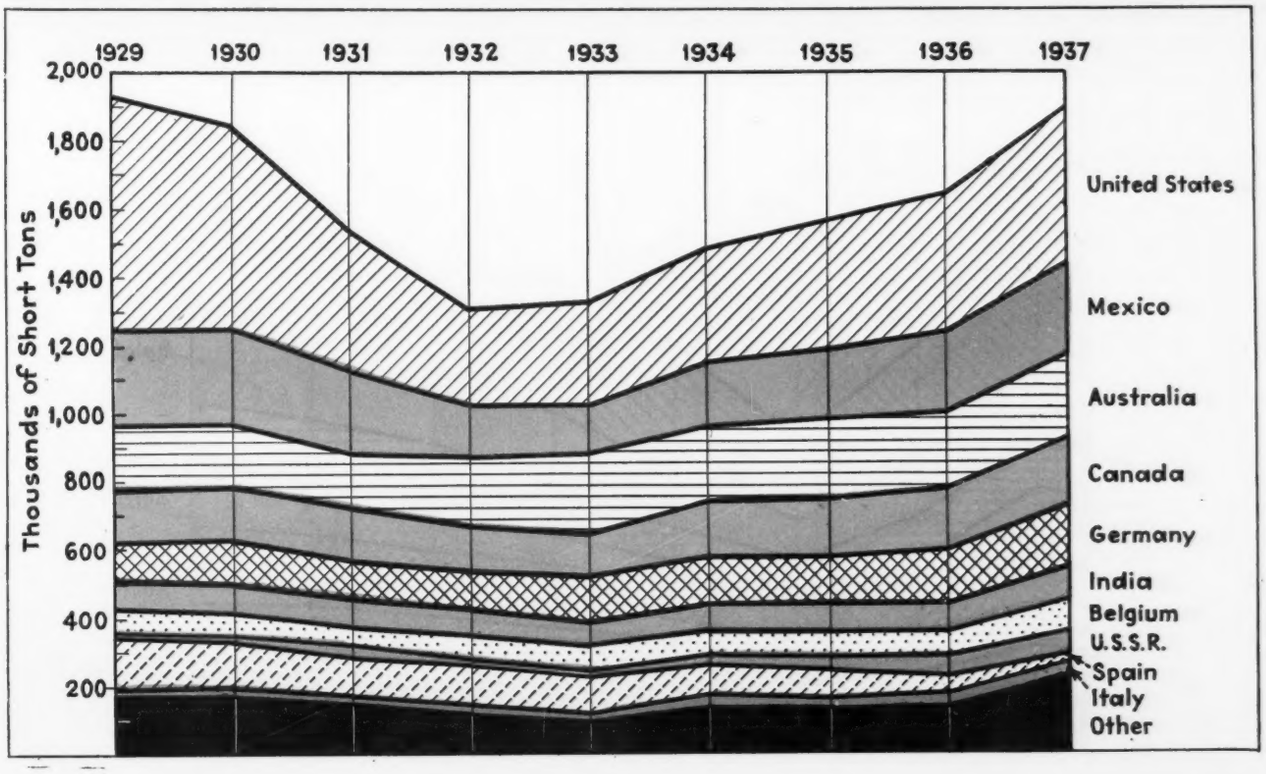


Trend in World COPPER Consumption

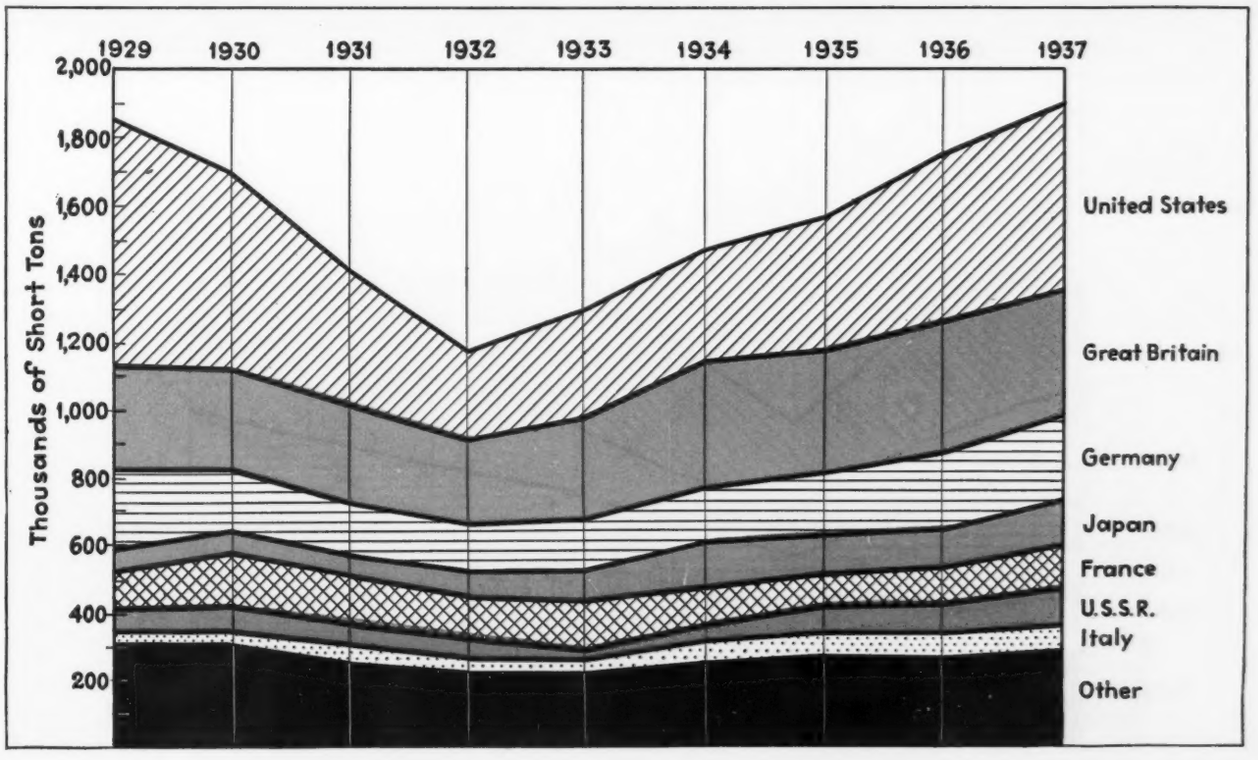


Source: 1929–1936, American Bureau of Metal Statistics; 1937, E&MJ estimate

Trend in World LEAD Production

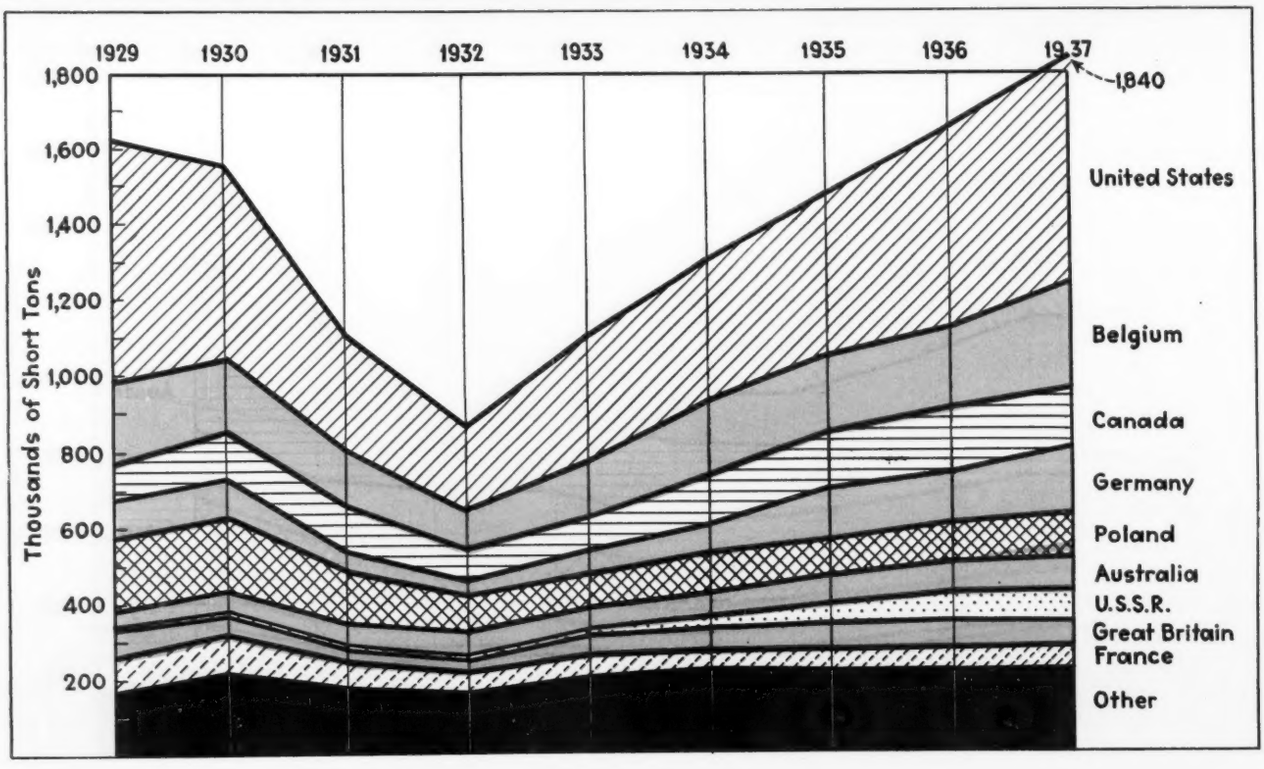


Trend in World LEAD Consumption

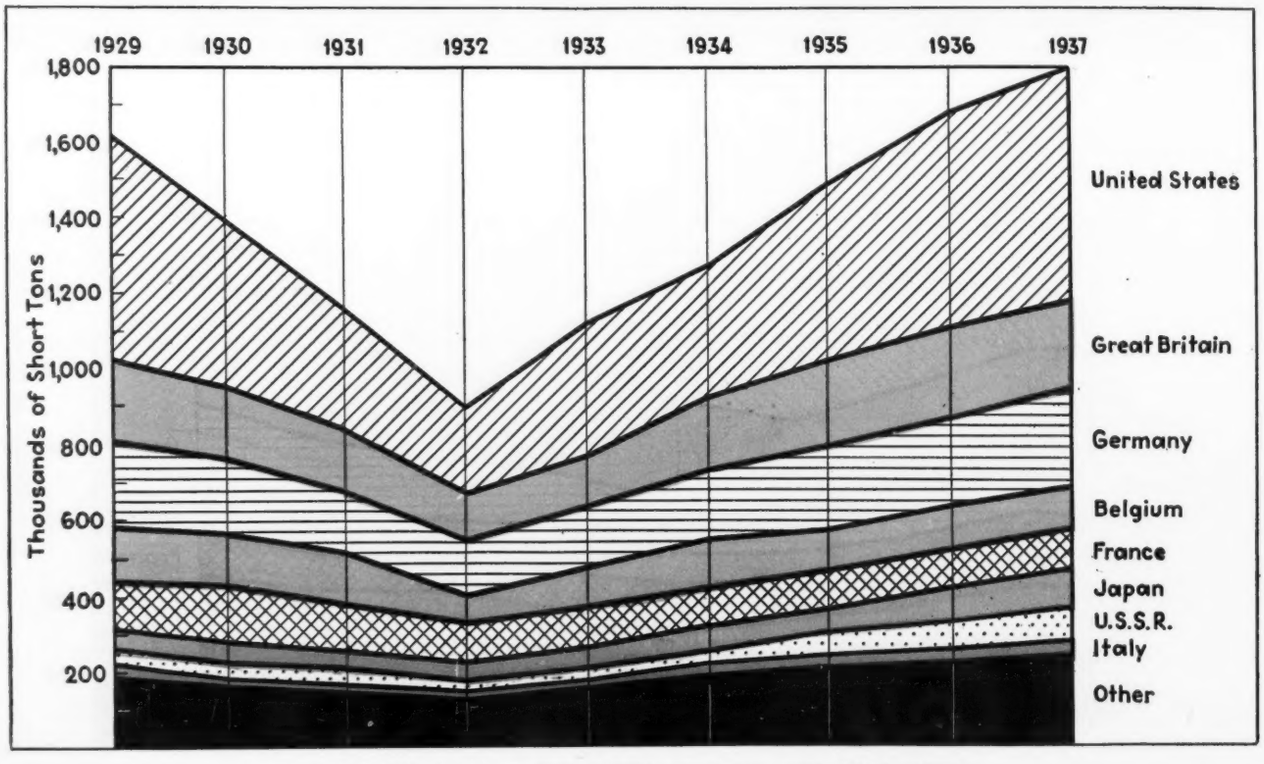


1929–1936, American Bureau of Metal Statistics; 1937, E&MJ estimate

Trend in World ZINC Production

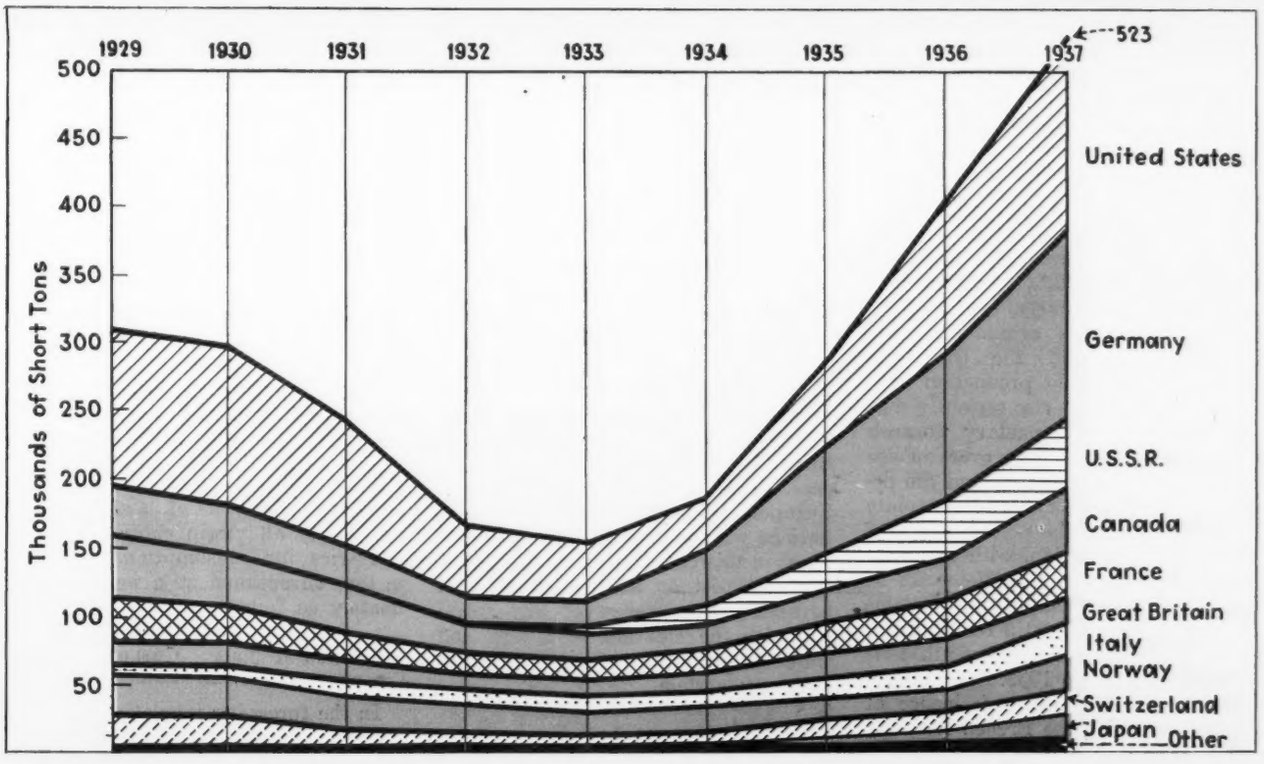


Trend in World ZINC Consumption

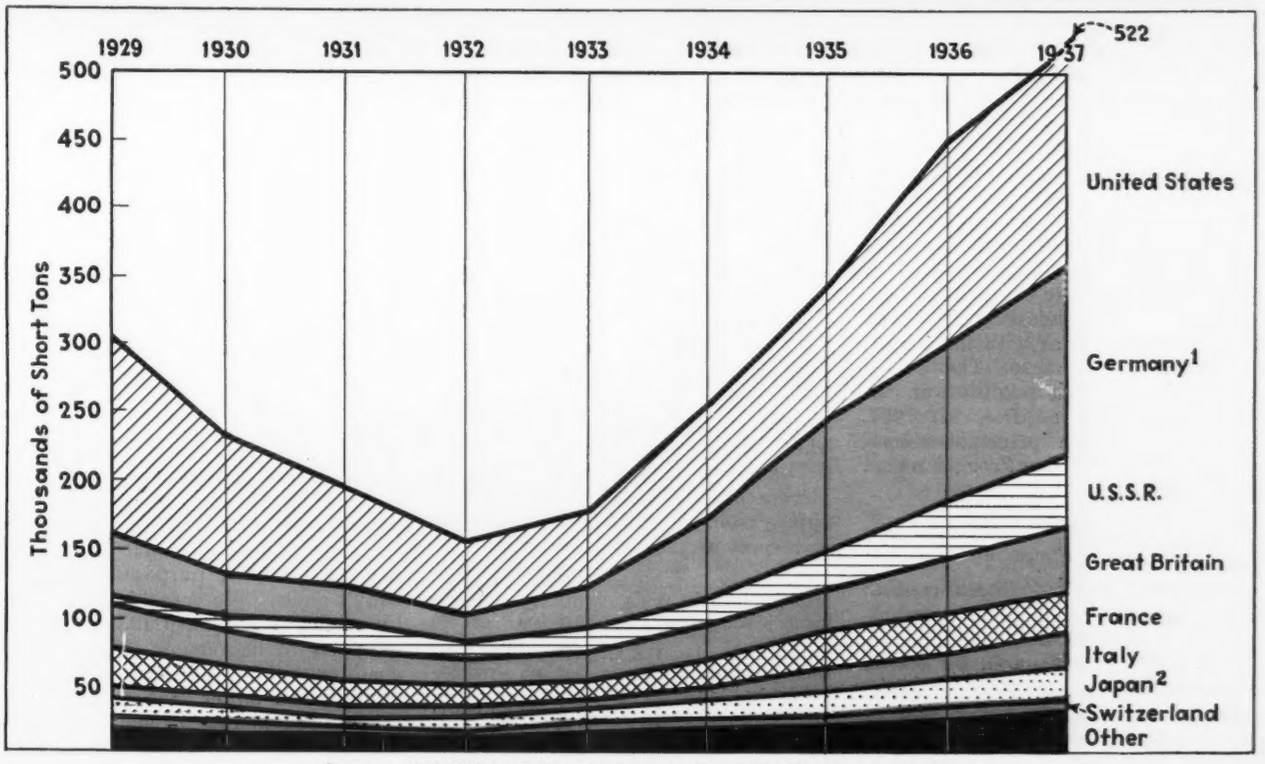


Source: 1929–1936, American Bureau of Metal Statistics; 1937, E&MJ estimate

Trend in World ALUMINUM Production



Trend in World ALUMINUM Consumption



Source: 1929–1936, Metallgesellschaft A.G.; 1937, E&MJ estimate

[1] Includes imported scrap 1929–36. [2] Includes other Asiatic countries, and scrap imported by Japan, 1931–36.

Gold

(Continued from page 38)

could be reduced and credit made available in large quantities. *In releasing gold to monetary use, or in reducing the amount of "sterilized" gold, the question of inflation will have to be carefully considered. If an excessive inflation is prevented it will require a continuation of close management of currency and credit.*

In last year's review of gold and in an article entitled "Gold Rumors," published in *E.&M.J.*, February and June, 1937, respectively, I enumerated the credit controls available to the Administration and the conclusion was drawn that gold production costs would probably not rise seriously during 1937. These monetary controls were applied vigorously over an extended period of the year and the deflation of commodity prices rapidly followed. During the period of recovery from the recession, with more unemployment in progress, the costs of gold production should not become adverse, in which event a record world gold production for the seventh time may be expected in 1938.

Despite the disturbing influence of further devaluing the French franc by removal of the "gold peg" the nations which joined the currency stabilization agreement of Sept. 25, 1936,—namely, Great Britain, France, Belgium, Netherlands, Switzerland, and the United States—were successful in the management of their respective Currency Stabilization Funds and marked stability in foreign exchange was maintained as compared with the widely fluctuating conditions of recent years.

Premier Paul van Zeeland of Belgium has been making a study of foreign trade and monetary matters and has completed his conferences with American authorities. Since resigning the Premiership he is reported on Jan. 7, 1938, to have expedited his research and to be discussing his report and recommendations with the British authorities at this time. The United Press in a dispatch published in the *Washington Post* of Dec. 27, 1937, indicated that the principal recommendations of the Van Zeeland report were to be as follows:

1. A ten-year customs truce.

2. Abolition of "clearing" systems.

3. Mobilization of "frozen credits" and creation of a currency equalization fund by the Bank of International Settlement, financed by central banks in each participating country, which would provide 1 per cent of their gold reserves entrusted to a permanent international commission.

It is understood that former Premier van Zeeland upon concluding his presentation to Great Britain will then make his report and recommendations to France, Italy, and Germany. This report will command the most careful consideration and it may become the nucleus for a progressive and permanent currency system, based on gold. Such a plan should conserve the use of gold, not only in effecting international settlements, but also in maintaining greater stability in foreign exchange. When such constructive action is taken, foreign trade will again be free to resume more normal conditions, expediting world economic recovery and afford greater stability in the price of gold. Secretary Morgenthau has indicated his readiness to cooperate at any time in a constructive plan to improve monetary conditions. He has expressed the belief that better results can be obtained through negotiations with individual nations, than could be had by international conference. The result of the Van Zeeland European monetary and trade negotiations will be awaited with great interest in this country, which has promised to assist at the proper time in advancing the interest of any sound plan for the creation of a new and more modern form of gold standard monetary system.

Copper

(Continued from page 39)

upward curve in true consumption flattens out there is no longer exigency to increase invisible inventory, and consequently a diminished requirement from refineries, that is, deliveries. It is possible therefore that while in the second half of 1937 apparent consumption abroad receded somewhat, there may not have been any recession in true consumption. Failure to recognize this condition may lead to over-production at some times; or under-production if the conditions are opposite.

At this writing, in the absence of all needful data and the necessary analysis and correlation of all data when complete, it is possible only to offer an approximate statistical picture of 1937, but roughly it will appear something like the following in respect of the United States:

	1936	1937
Mine production U.S.A...	615,000	843,000
Scrap production U.S.A..	160,000	190,000
Total production U.S.A..	775,000	1,033,000
Domestic sales of refined	995,000	550,000
Domestic deliveries refined	795,000	833,000
Domestic consumption...	749,000	880,000

This tabulation includes estimates for production, sales, and deliveries by secondary refiners, which however are relatively small. By domestic consumption is meant the final absorption into finished goods and installations, which at present can only be roughly figured as probably having approached 880,000 tons.

The sales of refined copper in 1937 were much less than in 1936, for the reason that deliveries in 1937 were largely against prior sales. Deliveries ex refineries in 1936 were substantially in excess of real consumption, the reason being that they were going largely into invisible stocks (in process, etc.). In 1937 things were the other way around, consumption being satisfied out of invisible stocks, especially during the latter part of the year. Mine production was stepped up too much, so that with an increased reflux of old copper, the total supply was in excess of consumption and there was consequently an increase in visible stocks.

Outside of the United States the production in terms of blister copper, practically all virgin copper, and the deliveries for consumption, computed in the conventional way, were approximately as follows:

	1936	1937
Production ex U.S.A..	1,206,000	1,600,000
Consumption ex U.S.A.	1,272,000	1,570,000

In the foregoing tabulation the comparisons between production and consumption do not synchronize exactly and the incidence of secondary copper is disregarded. There is no question, however, about there having been a large increase in foreign consumption, and also in production. In the latter part of the year steps were being taken to reduce the rate of production, while on the other hand the rate of consumption appeared to be well maintained. In respect of foreign consumption I venture to say no more than that the latest statistics are giving no omen of further recession.

Consumption in the United States in 1937 averaged about 73,000 tons per month, whereof we may estimate that about 16,000 tons per month was supplied by the reflux of old copper, leaving about 57,000 tons per month open for new copper. It will be futile to forecast probable domestic consumption in 1938. The requirements for automobile manufacture will probably be materially less; for telephone and telegraph purposes a little less; for refrigeration, air-conditioning, radio, etc., a little less. For building construction maybe about the same. For public utility purposes it is anybody's guess. We entered 1937 on an up grade. We entered 1938 in an atmosphere of depression. We have no good reason to anticipate a domestic consumption larger than in 1937 and the outlook is that it may be lower, but not so much lower as current monthly figures of sales and deliveries would appear to indicate.

Tin

(*Continued from page* 41)

therefore should make less surplus available for Malaya and the N.E.I., and if trade should contract more and quotas be further reduced, there is a possibility that Clause 22 of the Agreement, which permits withdrawal from the control scheme if outside production should exceed 12,500 tons, or 15 per cent of world output, for six months, may become an important proviso for Malaya.

Consumption or, more accurately, demand was also on a record scale and is estimated at something like 175,000 tons. The total visible stock at the end of 1937 was 25,711 tons—3,016 tons more than the year before. When allowance is made for this, there is approximately 20,000 to 22,000 tons surplus of production to account for, which is one of the main problems of the present time. One possible form which a buffer pool might assume, as discussed in the League Economic Committee's Report on Control of Raw Materials, is a consumers' pool; were such a measure in existence today it could go far to explain some of our statistical unconformities. Without any concerted operation of the kind, however, it is only reasonable to suppose that important buyers—not only in America—resolved to avoid the experience of 1935 and 1936, especially with stocks kept so low, and added largely to their invisible stock. The course of the next few months should enlighten us on this point.

Deliveries of tin undoubtedly increased generally, but the figures for various countries outside America are not available at the time of writing. Year-end statistics are less representative than formerly owing to increased volume of ex-works business. They do show an increase of 20,000 tons and correspond reasonably well to the improvement from 159,750 to 175,000 tons, which is the indicated improvement in consumption last year. This improvement was mainly in tin plate, which had a record year.

Prices, as with all the metals, enjoyed a boom in the first quarter of the year, and then gradually fell away for the subsequent nine months. The fluctuations were remarkable, varying in eight months between a high of £312 and a low of £175. Never has the failure of the Control to stabilize prices been more apparent. It is even possible that the existence of the power to cut output suddenly may have had an effect the very reverse of that desired, and induced buyers to hold larger stocks than they would be satisfied with in a free market. Be that as it may, the average for the year was £242 6s. 6d., against £204 12s. for cash Standard in London in 1936, or 54.337c., against 46.441c., for Straits in New York—a figure that is four times the production cost of some of the cheaper alluvial producers of the metal.

So much for our survey. What of the outlook for tin? The price is some £50 a ton below that ruling twelve months earlier. Stocks at 25,000 tons are not large, seeing they include smelters' carry-over. The International Committee did not wait for any considerable increase in stocks to reduce the quota from 110 to 70 per cent on Dec. 10. What the course of trade and consumption is going to be in the United States is anybody's guess. On a short-time view, whatever stocks consumers may now have at their disposal will represent a bigger reserve, in proportion as their rate of melting is reduced, and they may be well enough covered to feel no disposition to anticipate their normal buying because "tin is cheap today."

WORLD'S TIN PRODUCTION. . . In Long Tons

Country	1934	1935	1936	1937
Bolivia	20,634	27,168	24,074	24,500
Great Britain	1,999	2,050	2,125	2,150
China	7,878	9,500	10,500	10,200
Burma	4,061	4,102	4,270	4,300
Malaya	34,059	45,955	66,806	77,500
Siam	10,587	9,779	12,678	16,300
Netherlands E. I	18,418	24,632	31,546	39,700
Nigeria	4,996	7,029	9,529	9,600
Belgian Congo	4,356	6,118	7,280	9,300
Australia	2,986	3,130	3,000	3,400
Elsewhere	5,598	7,162	7,813	8,250
Totals...	115,572	146,625	179,621	205,200

Tin production figures are on ore basis. Source: American Bureau of Metal Statistics for 1934, 1935, and 1936; 1937, *E&MJ* estimate.

Zinc

(*Continued from page* 41)

instances, to delay in obtaining equipment. This deficiency in production plus an active summer market for zinc products brought the industry face to face with an acute shortage of metal.

"Most producers fought the recent advance in price to 7¼c. St. Louis, which opened the doors wide for foreign zinc. Rumors that domestic productive capacity was insufficient to meet consumer demand were denied, but explanations carried little weight when the statistics of the American Zinc Institute issued early in August showed only 13,561 tons in the hands of producers, compared with 88,517 tons on Aug. 1, 1936. Consumers, becoming unduly alarmed, insisted on buying metal in quantity and made a bad situation worse. Business on the books of producers mounted to more than 106,000 tons, with a substantial tonnage bought for early 1938 delivery."

It is the history of the metal markets that changes in sentiment are extremely rapid, and this was never better illustrated than when, late in September, with but little more than one week's supply of metal in sight, an easing off of the zinc price seemed immediately to relieve the anxiety of buyers about the adequacy of the stock. And so ended the first nine months of 1937.

In spite of the tight situation already outlined, it is interesting to note that imports of zinc did not increase to the extent which might have been expected. Compared to 4,444 tons imported in 1935 and 11,660 in 1936, the total for the first eleven months of 1937 was only 35,682 tons, which, though substantially larger than in the preceding years, represents but 6.6 per cent of the domestic shipments during the same period.

The zinc situation during the last three months of 1937 needs little comment, as it parallels that of other non-ferrous metals and is consequently familiar to all. Supplies of zinc have mounted beyond the summer's danger point as a result primarily of lower consumption. Partly because of the statistical situation, but largely due to the prevailing sentiment in the metal markets, the price declined by the end of December to 5c.—off 33⅓ per cent from the year's high.

The outlook for the near future is at least as favorable as is that for other metals. A year ago consuming industries, influenced by talk of inflation and a speculative boom abroad, rushed to buy raw materials of all kinds. The inflationary seeds are still there, but there is not so much talk about them at the moment. Supplies of zinc in the hands of producers are approximately 65,000 tons. Although this is a larger stock than a year ago, it is less than the stock at any other

(*Continued on page* 48)

E & M J
Annual Average Metal Prices 1897-1937

Year	Copper, (a) Electrolytic, Refinery	Tin, (b) New York	Lead Common, New York	Silver, New York	Zinc, Prime Western (d) E. St. Louis	Year	Copper, (a) Electrolytic, Refinery	Tin, (b) New York	Lead Common, New York	Silver, New York	Zinc, Prime Western (d) E. St. Louis
1897	11.29	13.67	3.58	59.790	4.12	1918	24.628	88.750	7.413	96.772	7.890
1898	12.03	15.70	3.78	58.260	4.57	1919	18.691	63.328	5.759	111.122	6.988
1899	16.67	25.12	4.47	59.580	5.75	1920	17.456	48.273	7.957	100.900	7.671
1900	16.19	29.90	4.37	61.330	4.39	1921	12.502	29.916	4.545	62.654	4.655
1901	16.11	26.74	4.33	58.950	4.07	1922	13.382	32.554	5.734	67.528	5.716
1902	11.626	26.79	4.069	52.160	4.84	1923	14.421	42.664	7.267	64.873	6.607
1903	13.235	28.09	4.237	53.570	5.191	1924	13.024	50.176	8.097	66.781	6.344
1904	12.823	27.99	4.309	57.221	4.931	1925	14.042	57.893	9.020	69.065	7.622
1905	15.590	31.358	4.707	60.352	5.730	1926	13.795	65.285	8.417	62.107	7 337
1906	19.278	39.819	5.657	66.791	6.048	1927	12.920	64.353	6.755	56.370	6.242
1907	20.004	38.166	5.325	65.237	5.812	1928	14.570	50.427	6.305	58.176	6.027
1908	13.208	29.465	4.200	52.864	4.578	1929	18.107	45.155	6.833	52.993	6.512
1909	12.982	29.725	4.273	51.502	5.352	1930	12.982	31.694	5.517	38.154	4.556
1910	12.738	34.123	4.446	53.486	5.370	1931	8.116	24.467	4.243	28.700	3.640
1911	12.376	42.281	4.420	53.340	5.608	1932	5.555	22.017	3.180	27.892	2.876
1912	16.341	46.096	4.471	60.835	6.799	1933	7.025	39.110	3.869	34.727	4.029
1913	15.269	44.252	4.370	59.791	5.504	1934	8.428	52.191	3.860	47.973 (e)	4.158
1914	13.662	34.301 (c)	3.862	54.811	5.061	1935	8.649	50.420	4.065	64.273 (e)	4.328
1915	17.275	38.590	4.673	49.684	13.054	1936	9.474	46.441	4.710	45.087 (e)	4.901
1916	27.202	43.480	6.858	65.661	12.634	1937	13.167	54.337	6.009	44.883 (e)	6.519
1917	27.180	61.802	8.787	81.417	8.813						

(a) Lake copper 1897 and 1898; domestic copper only since 1932. (b) 99 per cent tin, 1897 to 1920, inclusive; Straits tin thereafter. (c) Average for eleven months. (d) New York zinc 1897 to 1902, inclusive. (e) Other than newly mined domestic.

Prices are in cents per pound, except those for silver, which are in cents per troy ounce.

Nickel

Extensive use of this metal in alloys points to gain of 24 per cent in consumption during 1937

Robert C. Stanley

Chairman and President
International Nickel Company of Canada

WORLD consumption of nickel in all of its forms during the first ten months of 1937 attained a total of approximately 201,000,000 lb., an increase of about 24 per cent over the corresponding figure for 1936. It compares with 112,000,000 lb. in the first ten months of 1929.

Factors which contributed to this increase were the better pace of world business, the larger output of products containing nickel as an established component, introduction of nickel into new products, and the spread of nickel consumption to new industrial countries.

Another significant factor in nickel consumption has been the rapid development of mass production by manufacturing processes involving highly corrosive conditions, where nickel, high nickel alloys, monel, stainless steel, and the various alloy-clad steels provide industry with materials combining requisite strength with the essential resistance to corrosion.

Although the final figures for 1937 will show minor variations, the following percentages give a general picture of the relative importance of the various forms in which nickel enters world industry:

	Per Cent
Steel (a)	55
Nickel cast iron	5
Nickel-iron alloys	1
Nickel-copper and nickel silvers	10
Nickel brass, bronze, and aluminum alloy castings	2
Heat-resistant and electrical resistance alloys	3
Monel, malleable nickel, nickel-clad and Inconel	12
Electrodeposition	10
Non-metallic materials for the chemical industry, nickel salts, ceramic materials, storage battery materials, and catalysts	1
Unclassified	1

(a) Constructional steels, stainless steels and other corrosion- and heat-resisting steels, and steel castings.

The rapid expansion in the use of stainless steels has contributed to the growth in the use of nickel. Estimates for 1937 indicate an ingot production of from 75,000 to 100,000 tons of nickel-bearing stainless steels, with an average nickel content of approximately 9 per cent.

There are many different compositions of stainless steel in commercial use. The most widely known type, which contains 18 per cent chromium and 8 per cent nickel, has shown spectacular commercial development. Removal of the carbide difficulties through the addition of titanium or columbium is a noteworthy step forward, and the use of the molybdenum-bearing material has been highly successful where corrosive conditions are unusually severe.

Developments in the mining field have included further progress with 2 per cent nickel steel for mine cage couplings, this material now being standard in the major French and Belgian mines. Plates and angles of 3½ per cent nickel steel were specified for 123 Granby-type mine cars ordered by a Canadian mining company, and the use of nickel steel for mine car axles increased. Interest in mine cages of weldable nickel-chromium-molybdenum steel was renewed.

The drum shafts of Canada's largest electric hoist, recently installed in the Creighton mine, near Sudbury, Ont., are steel forgings containing 3.5 per cent of nickel. The drum shells are of 1½ per cent nickel cast iron.

Zinc

(*Continued from page* 47)

year-end back to 1929, and it represents but six weeks' supply at the average rate of consumption in 1936 and 1937. Inventories in the hands of consumers vary, and where these are large, they must be worked off. As mentioned before, however, changes in sentiment in the metal markets are extremely rapid. Little can be expected from possible accomplishments over a short period within the zinc industry itself. A far greater effect upon the zinc situation will result from a general improvement in conditions, stimulating sales of automobiles and aiding the long-delayed upturn in building construction.

E & M J METAL PRICES FOR 1937 • BY DAYS

Including Monthly Highs and Lows and Monthly Averages

JANUARY

Jan.	Copper, Electrolytic Domestic	Copper, Electrolytic Export	Tin, Straits, New York	Lead, Common, New York	Silver, New York	Zinc, Prime Western E. St. Louis
1	Holiday	11.650	Holiday	Holiday	Holiday	Holiday
2	11.775	11.625	51.650	6.00	.....	5.45
4	11.775	11.650	51.250	6.00	45.000	5.45
5	11.775	11.650	50.950	6.00	45.000	5.45
6	11.775	11.575	51.000	6.00	45.000	5.45
7	11.775	11.675	51.375	6.00	45.500	5.45
8	11.775	11.750	51.325	6.00	45.250	5.55@5.60
9	11.775	11.950	51.200	6.00	.....	5.60
11	11.775@12.275	12.200	51.325	6.00	45.375	5.80
12	12.275	12.325	51.125	6.00	45.125	5.90@6.00
13	12.275	12.350	51.000	6.00	45.000	6.00
14	12.275@12.775	12.550	51.150	6.00	44.750	6.00
15	12.775	12.475	51.500	6.00	44.750	6.00
16	12.775	12.400	51.500	6.00	.....	6.00
18	12.775	12.350	51.325	6.00	44.750	6.00
19	12.775	11.975	51.000	6.00	44.750	6.00
20	12.775	12.075	51.100	6.00	44.750	6.00
21	12.775	12.300	51.100	6.00	44.750	6.00
22	12.775	12.300	51.000	6.00	44.750	6.00
23	12.775	12.350	50.900	6.00	.....	6.00
25	12.775	12.175	50.050	6.00	44.750	6.00
26	12.775	12.225	50.350	6.00	44.750	6.00
27	12.775	12.350	50.100	6.00	44.750	6.00
28	12.775	12.325	50.150	6.00	44.750	6.00
29	12.775	12.325	49.850	6.00	44.750	6.00
30	12.775	12.325	49.850	6.00	.....	6.00
High	**12.775**	**12.550**	**51.650**	**6.000**	**45.500**	**6.000**
Low	**11.775**	**11.575**	**49.850**	**6.000**	**44.750**	**5.450**
Average	**12.415**	**12.112**	**50.925**	**6.000**	**44.913**	**5.847**

FEBRUARY

Feb.	Copper, Domestic	Export	Tin	Lead	Silver	Zinc
1	12.775	12.325	49.900	6.00	44.750	6.000
2	12.775	12.475	50.500	6.00	44.750	6.000
3	12.775	12.600	51.000	6.00	44.750	6.000
4	12.775	12.750	50.550	6.00	44.750	6.225
5	12.775	12.800	50.000	6.00	44.750	6.250
6	12.775	12.850	50.125	6.00	.....	6.250
8	12.775	12.875	50.375	6.00	44.750	6.250@6.400
9	12.775	13.000	50.225	6.00	44.750	6.400
10	12.775	13.075	50.525	6.00	44.750	6.400
11	12.775	13.150	51.250	6.00	44.750	6.400
12	12.775	13.275	Holiday	Holiday	Holiday	6.400
13	12.775	13.250	50.750	6.00	.....	6.400
15	12.775	13.150	51.100	6.00	44.750	6.400
16	13.775	13.200	51.350	6.00	44.750	6.400
17	13.775	13.625	51.700	6.00	44.750	6.400
18	13.775	13.850	52.250	6.25	44.750	6.600
19	13.775	14.300	53.875	6.50	44.750	6.60@6.80
20	13.775@14.775	14.900	54.000	6.50	.....	6.80
22	Holiday	15.950	Holiday	Holiday	Holiday	6.80
23	13.775@14.775	15.575	55.600	6.50	44.750	6.80
24	14.775	15.400	54.650	6.50	44.750	6.80
25	14.775	15.775	55.250	7.00	44.750	6.80
26	14.775	15.925	54.750	7.00	44.750	6.80
27	14.775	15.800	54.500	7.00	.....	6.80
High	**14.775**	**15.950**	**55.600**	**7.000**	**44.750**	**6.800**
Low	**12.775**	**12.325**	**49.900**	**6.000**	**44.750**	**6.000**
Average	**13.427**	**13.828**	**52.010**	**6.239**	**44.750**	**6.465**

MARCH

Mar.	Copper, Domestic	Export	Tin	Lead	Silver	Zinc
1	14.775	15.625	54.000	7.00	44.750	6.80
2	14.775	15.750	55.150	7.00	44.750	7.00
3	14.775	16.000	57.000	7.00	44.750	7.00
4	14.775	16.050	57.250	7.00	45.250	7.00
5	14.775	16.100	58.000	7.00	45.000	7.00
6	14.775	16.000	59.000	7.00	.....	7.00
8	16.025	16.250	60.000	7.25	45.000	7.50
9	16.025	16.500	63.000	7.50	44.750	7.50
10	16.025	16.650	66.000	7.75	44.875	7.50
11	16.025	17.100	64.625	7.75	45.000	7.50
12	16.025	16.850	66.250	7.75	45.250	7.50
13	16.025	17.025	66.750	7.75	.....	7.50
15	16.025	17.150	66.750	7.75	45.375	7.50
16	16.025	16.850	65.000	7.50	45.625	7.50
17	16.025	16.750	65.500	7.25	45.750	7.50
18	16.025	16.850	66.000	7.25	45.625	7.50
19	16.025	16.800	64.125	7.00	45.250	7.50
20	16.025	16.600	63.750	7.00	.....	7.50
22	16.025	16.475	62.000	7.00	45.250	7.50
23	16.025	16.325	64.000	6.975	45.250	7.50
24	16.025	16.450	65.375	6.95	45.000	7.50
25	16.025	16.975	66.000	6.95	45.000	7.50
26	16.025	16.950	66.000	6.95	45.000	7.50
27	16.025	19.950	66.000	6.95	.....	7.50
29	16.025	16.950	65.875	6.95	45.000	7.50
30	16.025	17.000	63.750	6.95	45.250	7.50
31	16.775	16.950	65.000	6.95	45.250	7.50
High	**16.775**	**17.150**	**66.750**	**7.750**	**45.750**	**7.500**
Low	**14.775**	**15.625**	**54.000**	**6.950**	**44.750**	**6.800**
Average	**15.775**	**16.590**	**63.043**	**7.190**	**45.130**	**7.381**

APRIL

April	Copper, Electrolytic Domestic	Copper, Electrolytic Export	Tin, Straits, New York	Lead, Common, New York	Silver, New York	Zinc, Prime Western E. St. Louis
1	16.775	16.625	63.625	6.95	45.250	7.50
2	16.775	16.075	62.625	6.90	45.250	7.50
3	16.775	16.075	62.625	6.90	.....	7.50
5	16.775	15.750	62.875	6.90	46.625	7.50
6	15.775	15.525	61.700	6.90	46.750	7.50
7	15.775	14.600	60.250	6.00	46.000	7.00@7.50
8	15.275	15.000	60.250	6.00	45.875	7.00
9	15.275	15.200	60.500	6.00	46.125	7.00
10	15.275	15.250	61.250	6.00	.....	7.00
12	15.275	14.900	60.000	6.00	46.000	7.00
13	15.275	14.850	60.600	6.00	46.000	7.00
14	15.275	15.000	61.000	6.00	45.750	7.00
15	15.275	15.025	59.800	6.00	45.500	7.00
16	15.275	14.800	58.500	6.00	45.250	7.00
17	15.275	14.800	58.500	6.00	.....	7.00
19	15.275	14.400	57.375	6.00	45.250	7.00
20	14.275	13.525	56.375	6.00	44.750	6.75
21	14.275	13.875	58.000	6.00	44.750	6.75
22	14.275	14.050	59.500	6.00	44.750	6.75
23	14.275	14.250	57.250	6.00	44.750	6.75
24	14.275	14.250	57.000	6.00	.....	6.75
26	14.275	13.900	55.375	6.00	44.875	6.75
27	14.275	13.600	57.250	6.00	45.000	6.75
28	14.275	13.600	56.000	6.00	45.375	6.75
29	13.775	13.475	55.000	6.00	45.250	6.75
30	13.775	13.600	55.250	6.00	45.000	6.75
High	**16.775**	**16.625**	**63.625**	**6.950**	**46.750**	**7.500**
Low	**13.775**	**13.475**	**55.000**	**6.000**	**44.750**	**6.750**
Average	**15.121**	**14.692**	**59.172**	**6.175**	**45.460**	**7.010**

MAY

May	Copper Domestic	Copper Export	Tin	Lead	Silver	Zinc
1	13.775	13.600	55.500	6.00	.....	6.75
3	13.775	13.875	57.125	6.00	45.000	6.75
4	13.775	14.000	56.000	6.00	45.000	6.75
5	13.775	13.900	55.625	6.00	45.125	6.75
6	13.775	13.950	54.900	6.00	45.125	6.75
7	13.775	13.900	55.325	6.00	45.000	6.75
8	13.775	13.975	55.450	6.00	.....	6.75
10	13.775	14.000	55.375	6.00	45.000	6.75
11	13.775	13.900	54.700	6.00	45.000	6.75
12	13.775	13.900	54.700	6.00	45.000	6.75
13	13.775	13.900	54.700	6.00	45.000	6.75
14	13.775	13.800	54.625	6.00	45.250	6.75
15	13.775	13.825	55.000	6.00	.....	6.75
17	13.775	13.850	55.000	6.00	45.250	6.75
18	13.775	14.050	55.250	6.00	45.125	6.75
19	13.775	14.275	56.375	6.00	45.000	6.75
20	13.775	14.200	56.125	6.00	44.875	6.75
21	13.775	14.150	56.575	6.00	44.875	6.75
22	13.775	14.050	56.375	6.00	.....	6.75
24	13.775	14.150	56.800	6.00	44.875	6.75
25	13.775	14.325	56.750	6.00	45.000	6.75
26	13.775	14.275	56.000	6.00	45.000	6.75
27	13.775	14.175	55.750	6.00	45.000	6.75
28	13.775	14.100	55.625	6.00	45.000	6.75
29	13.775	14.100	55.625	6.00	.....	6.75
31	Holiday	13.750	Holiday	Holiday	Holiday	Holiday
High	**13.775**	**14.325**	**57.125**	**6.000**	**45.250**	**6.750**
Low	**13.775**	**13.600**	**54.625**	**6.000**	**44.875**	**6.750**
Average	**13.775**	**13.999**	**55.651**	**6.000**	**45.025**	**6.750**

JUNE

June	Copper Domestic	Copper Export	Tin	Lead	Silver	Zinc
1	13.775	13.800	55.875	6.00	44.875	6.75
2	13.775	14.000	56.375	6.00	45.000	6.75
3	13.775	13.850	56.000	6.00	45.000	6.75
4	13.775	13.750	55.875	6.00	45.000	6.75
5	13.775	13.700	56.375	6.00	.....	6.75
7	13.775	13.775	56.100	6.00	45.000	6.75
8	13.775	13.700	56.000	6.00	45.000	6.75
9	13.775	13.650	55.875	6.00	44.875	6.75
10	13.775	13.350	55.500	6.00	44.750	6.75
11	13.775	13.300	55.575	6.00	44.750	6.75
12	13.775	13.300	55.400	6.00	.....	6.75
14	13.775	13.350	54.625	6.00	44.750	6.75
15	13.775	12.800	54.625	6.00	44.750	6.75
16	13.775	13.150	55.200	6.00	44.750	6.75
17	13.775	13.300	55.125	6.00	44.750	6.75
18	13.775	13.275	55.125	6.00	44.750	6.75
19	13.775	13.275	55.250	6.00	.....	6.75
21	13.775	13.125	55.125	6.00	44.750	6.75
22	13.775	13.150	55.600	6.00	44.750	6.75
23	13.775	13.275	55.875	6.00	44.750	6.75
24	13.775	13.575	56.500	6.00	44.750	6.75
25	13.775	13.750	57.250	6.00	44.750	6.75
26	13.775	13.800	57.250	6.00	.....	6.75
28	13.775	13.775	56.875	6.00	44.750	6.75
29	13.775	13.525	56.250	6.00	44.750	6.75
30	13.775	13.500	56.500	6.00	44.750	6.75
High	**13.775**	**14.000**	**57.250**	**6.000**	**45.000**	**6.750**
Low	**13.775**	**13.800**	**54.625**	**6.000**	**44.750**	**6.750**
Average	**13.775**	**13.492**	**55.851**	**6.000**	**44.818**	**6.750**

E & M J METAL PRICES FOR 1937 • BY DAYS

Including Monthly Highs and Lows and Monthly Averages

JULY

July	Copper Domestic	Export	Tin	Lead	Silver	Zinc
1	13.775	13.550	57.750	6.00	44.750	6.75
2	13.775	13.575	57.500	6.00	44.750	6.75
3	13.775	13.575	57.500	6.00	.....	6.75
5	Holiday	13.775	Holiday	Holiday	Holiday	Holiday
6	13.775	13.875	59.125	6.00	44.750	6.75
7	13.775	14.025	59.875	6.00	44.750	6.75
8	13.775	13.825	59.625	6.00	44.750	6.75
9	13.775	13.800	59.375	6.00	44.750	6.75
10	13.775	13.800	59.400	6.00	.....	6.75
12	13.775	13.800	59.125	6.00	44.750	7.00
13	13.775	13.850	59.750	6.00	44.750	7.00
14	13.775	13.750	60.125	6.00	44.750	7.00
15	13.775	13.625	59.625	6.00	44.750	7.00
16	13.775	13.675	60.000	6.00	44.750	7.00
17	13.775	13.675	60.000	6.00	.....	7.00
19	13.775	13.675	59.750	6.00	44.750	7.00
20	13.775	13.775	60.250	6.00	44.750	7.00
21	13.775	13.825	60.000	6.00	44.750	7.00
22	13.775	13.825	59.625	6.00	44.750	7.00
23	13.775	13.875	59.300	6.00	44.750	7.00
24	13.775	13.850	59.300	6.00	.....	7.00
26	13.775	13.925	59.125	6.00	44.750	7.00
27	13.775	13.950	59.000	6.00	44.750	7.00
28	13.775	13.975	59.250	6.00	44.750	7.00
29	13.775	14.000	59.000	6.00	44.750	7.00
30	13.775	14.100	58.500	6.00	44.750	7.00
31	13.775	14.100	58.500	6.00	.....	7.00
High	**13.775**	**14.100**	**60.250**	**6.000**	**44.750**	**7.000**
Low	**13.775**	**13.550**	**57.500**	**6.000**	**44.750**	**6.750**
Average	**13.775**	**13.817**	**59.245**	**6.000**	**44.750**	**6.923**

AUGUST

Aug.	Copper Domestic	Export	Tin	Lead	Silver	Zinc
2	13.775	14.100	58.750	6.00	44.750	7.00
3	13.775	14.125	58.875	6.00	44.750	7.00
4	13.775	14.150	59.000	6.25	44.750	7.00
5	13.775	14.250	60.375	6.50	44.750	7.00
6	13.775	14.325	60.400	6.50	44.750	7.00
7	13.775	14.350	60.425	6.50	.....	7.00
9	13.775	14.450	60.400	6.50	44.750	7.25
10	13.775	14.500	60.000	6.50	44.750	7.25
11	13.775	14.350	59.750	6.50	44.750	7.25
12	13.775	14.025	60.000	6.50	44.750	7.25
13	13.775	13.950	60.125	6.50	44.750	7.25
14	13.775	13.950	60.000	6.50	.....	7.25
16	13.775	13.925	59.625	6.50	44.750	7.25
17	13.775	13.850	59.750	6.50	44.750	7.25
18	13.775	13.850	59.625	6.50	44.750	7.25
19	13.775	13.850	59.625	6.50	44.750	7.25
20	13.775	13.825	59.500	6.50	44.750	7.25
21	13.775	13.800	59.500	6.50	.....	7.25
23	13.775	13.725	59.500	6.50	44.750	7.25
24	13.775	13.700	58.875	6.50	44.750	7.25
25	13.775	13.700	59.125	6.50	44.750	7.25
26	13.775	13.600	58.750	6.50	44.750	7.25
27	13.775	13.475	58.625	6.50	44.750	7.25
28	13.775	13.400	58.500	6.50	.....	7.25
30	13.775	13.400	58.375	6.50	44.750	7.25
31	13.775	13.450	58.625	6.50	44.750	7.25
High	**13.775**	**14.500**	**60.425**	**6.500**	**44.750**	**7.250**
Low	**13.775**	**13.400**	**58.375**	**6.000**	**44.750**	**7.000**
Average	**13.775**	**13.926**	**59.465**	**6.452**	**44.750**	**7.192**

SEPTEMBER

Sept.	Copper Domestic	Export	Tin	Lead	Silver	Zinc
1	13.775	13.475	58.625	6.50	44.750	7.25
2	13.775	13.325	58.375	6.50	44.750	7.25
3	13.775	13.350	58.625	6.50	44.750	7.25
4	13.775	13.375	58.625	6.50	.....	7.25
6	Holiday	13.400	Holiday	Holiday	Holiday	Holiday
7	13.775	13.450	58.500	6.50	44.750	7.25
8	13.775	13.550	58.750	6.50	44.750	7.25
9	13.775	13.575	59.125	6.50	44.750	7.25
10	13.775	13.525	59.625	6.50	44.750	7.25
11	13.775	13.550	59.625	6.50	.....	7.25
13	13.775	13.525	59.625	6.50	44.750	7.25
14	13.775	13.450	59.785	6.50	44.750	7.25
15	13.775	13.350	59.875	6.50	44.750	7.25
16	13.775	13.050	59.300	6.50	44.750	7.25
17	13.775	12.800	59.300	6.50	44.750	7.25
18	13.775	12.950	59.250	6.50	.....	7.25
20	13.775	12.650	58.675	6.50	44.750	7.25
21	13.775	12.625	59.675	6.50	44.750	7.25
22	13.775	12.625	59.675	6.50	44.750	7.25
23	13.775	12.575	59.375	6.50	44.750	7.25
24	13.025@13.775	12.525	57.975	6.25	44.750	7.25
25	13.775	12.525	57.750	6.25	.....	7.25
27	12.775	12.500	57.625	6.00	44.750	7.25
28	12.775	12.450	57.750	6.00	44.750	7.25
29	11.775	11.700	55.625	6.00	44.750	6.50
30	11.775@12.275	11.700	55.750	6.00	44.750	6.50
High	**13.775**	**13.575**	**59.875**	**6.500**	**44.750**	**7.250**
Low	**11.775**	**11.700**	**55.625**	**6.000**	**44.750**	**6.500**
Average	**13.530**	**12.984**	**58.675**	**6.400**	**44.750**	**7.190**

OCTOBER

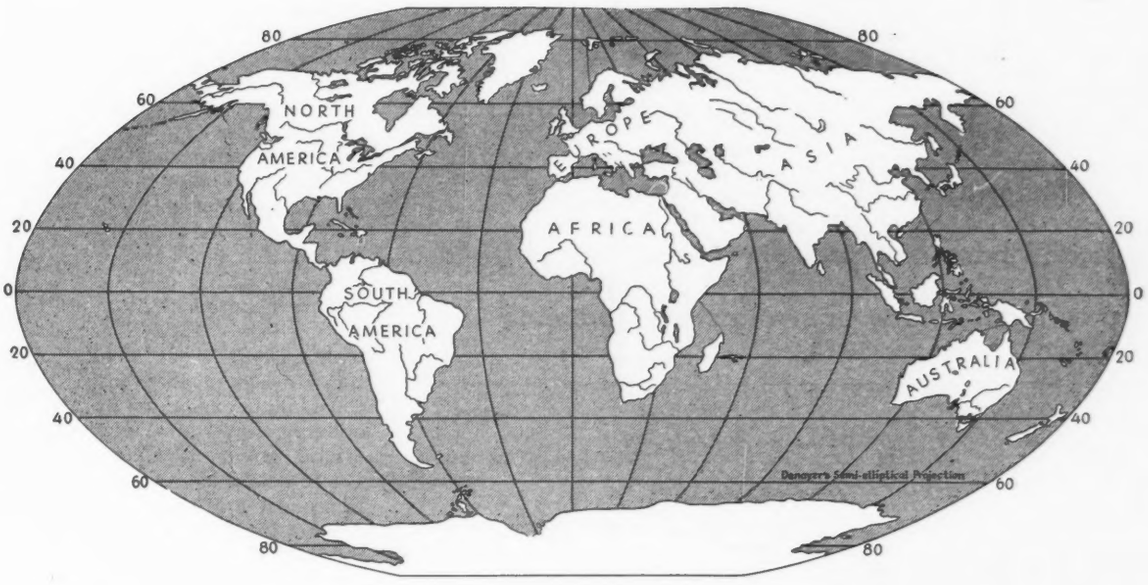
Oct.	Copper Domestic	Export	Tin	Lead	Silver	Zinc
1	12.275	11.850	56.250	6.00	44.750	6.50
2	12.275	11.950	57.250	6.00	.....	6.50
4	12.525	12.125	57.625	6.00	44.750	6.50
5	12.275	12.100	55.625	6.00	44.750	6.50
6	11.775	11.600	54.625	6.00	44.750	6.25
7	11.775	11.625	54.750	6.00	44.750	6.25
8	11.775	11.650	55.000	6.00	44.750	6.25
9	11.775	11.600	54.375	6.00	.....	6.25
11	11.775	11.650	54.000	6.00	44.750	6.25
12	11.775	11.600	52.625	Holiday	Holiday	Holiday
13	11.775	11.500	51.625	6.00	44.750	6.25
14	11.775	11.300	51.875	6.00	44.750	6.00@6.25
15	11.775	11.225	50.500	5.75	44.750	6.00
16	11.775	11.200	50.250	5.75	.....	6.00
18	11.775	11.200	50.625	5.50	44.750	6.00
19	11.775	10.500	48.250	5.50	44.750	6.00
20	11.775	10.550	48.375	5.50	44.750	6.00
21	11.775	10.825	50.375	5.50	44.750	6.00
22	11.775	10.900	49.750	5.50	44.750	6.00
23	11.775	10.900	49.375	5.50	.....	6.00
25	11.775	10.525	48.250	5.50	44.750	5.75
26	11.775	10.625	48.625	5.50	44.750	5.75
27	11.775	10.450	47.750	5.50	44.750	5.75
28	11.525@11.775	10.600	48.750	5.50	44.750	5.75
29	11.525	10.650	48.500	5.50	44.750	5.75
30	11.525	10.675	48.000	5.50	.....	5.75
High	**12.525**	**12.125**	**57.625**	**6.000**	**44.750**	**6.500**
Low	**11.525**	**10.450**	**47.750**	**5.500**	**44.750**	**5.750**
Average	**11.838**	**11.207**	**51.654**	**5.740**	**44.750**	**6.085**

NOVEMBER

Nov.	Copper Domestic	Export	Tin	Lead	Silver	Zinc
1	11.525	10.600	47.625	5.50	44.750	5.75
2	Holiday	10.500	Holiday	Holiday	Holiday	Holiday
3	11.525	10.300	46.000	5.25	44.750	5.75
4	11.275	10.250	45.125	5.00	44.750	5.75
5	10.775	9.900	44.250	5.00	44.750	5.75
6	10.775	9.900	43.875	5.00	.....	5.75
8	10.775	9.325	42.250	5.00	44.750	5.75
9	10.775	9.850	43.000	5.00	44.750	5.75
10	10.775	9.850	44.375	5.00	44.750	5.75
11	Holiday	10.150	Holiday	Holiday	Holiday	Holiday
12	10.775	10.200	45.500	5.00	44.750	5.75
13	10.775	10.250	45.250	5.00	.....	5.75
15	10.775	10.250	45.000	5.00	44.750	5.75
16	10.775	9.975	43.000	5.00	44.750	5.75
17	10.775	9.850	42.875	5.00	44.750	5.75
18	10.775	9.800	41.500	5.00	44.750	5.75
19	10.775	9.500	41.750	5.00	44.750	5.75
20	10.775	9.450	41.125	5.00	.....	5.75
22	10.775	9.450	41.000	5.00	44.750	5.50
23	10.525	9.400	41.625	5.00	44.750	5.50
24	10.525	9.425	41.750	5.00	44.750	5.50
25	Holiday	9.500	Holiday	Holiday	Holiday	Holiday
26	10.525	9.500	41.750	5.00	44.750	5.25
27	10.525	9.500	42.375	5.00	.....	5.25
29	10.525	9.700	42.375	5.00	44.750	5.25
30	10.525	9.725	42.500	5.00	44.750	5.25
High	**11.525**	**10.600**	**47.625**	**5.500**	**44.750**	**5.750**
Low	**10.525**	**9.400**	**41.000**	**5.000**	**44.750**	**5.250**
Average	**10.797**	**9.850**	**43.299**	**5.033**	**44.750**	**5.630**

DECEMBER

Dec.	Co pper Domestic	Export	Tin	Lead	Silver	Zinc
1	10.275	9.775	43.250	5.00	44.750	5.25
2	9.775 @ 10.275	9.825	43.500	5.00	44.750	5.00
3	9.775 @ 10.275	9.850	44.125	5.00	44.750	5.00
4	10.275	9.925	44.875	5.00	.....	5.00
6	10.275	10.050	44.875	5.00	44.750	5.00
7	10.150@10.275	10.000	43.875	5.00	44.750	5.00
8	10.150@10.275	10.000	43.750	5.00	44.750	5.00
9	10.025	9.875	44.000	5.00	44.750	5.00
10	10.025	9.775	44.750	5.00	44.750	5.00
11	10.025	9.700	45.400	5.00	.....	5.00
13	10.025	9.675	44.125	5.00	44.750	5.00
14	10.025	9.550	43.375	5.00	44.750	5.00
15	10.025	9.550	43.250	5.00	44.750	5.00
16	9.900	9.575	43.500	4.75	44.750	5.00
17	9.900	9.675	42.625	4.75	44.750	5.00
18	9.900	9.725	42.500	4.75	.....	5.00
20	9.900	9.725	42.250	4.75	44.750	5.00
21	9.900	9.725	42.000	4.75	44.750	5.00
22	9.900	9.750	42.750	4.75	44.750	5.00
23	9.900	9.700	42.175	4.75	44.750	5.00
24	9.900	9.675	42.000	4.75	44.750	5.00
25	Holiday	Holiday	Holiday	Holiday	Holiday	Holiday
27	9.900	9.675	42.000	4.75	44.750	5.00
28	9.900	9.500	41.000	4.75	44.750	5.00
29	9.900	9.375	41.125	4.75	44.750	5.00
30	9.900	9.425	41.250	4.75	44.750	5.00
31	9.900	9.500	41.000	4.75	44.750	5.00
High	**10.275**	**10.050**	**45.400**	**5.000**	**44.750**	**5.250**
Low	**9.900**	**9.375**	**41.000**	**4.750**	**44.750**	**5.000**
Average	**10.006**	**9.714**	**43.051**	**4.875**	**44.750**	**5.010**



Mining the World Over

THE WHOLE WORLD is the mining man's "parish." No country so remote, nor journey difficult, nor climate evil, for him, if only the lure of mineral wealth is there, and fortune, or even a profit, beckons. With or without the funds for completion of his enterprise, he has fared forth to seek his luck, hoping like Jason to return with the golden fleece. Time, while it has narrowed his chances of new discovery, has also worked a transmutation of a sort, constantly making substances once worthless commercially valuable. With explorer and trader he has vied in opening new lands, to obtain these materials for industry and civilization. The ultimate results of his labors are seen in the cargoes of ore and their finished products crossing oceans and continents in the exchange of goods. *E. & M. J.'s* windows, high above a world metropolis and seaport, look down upon this traffic of the nations. Ships and trains, arriving and departing, link it with its readers and correspondents throughout the world. Through the latter it endeavors to depict in each issue the progress and new developments that are taking place in mining countries. From them, it presents in the succeeding pages a summary of the happenings of the last twelve months.

Canada

Mineral output sets record for non-metallics and base and precious metals. Gold yield at new high. Many mines to start producing

John B. DeMille

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IN SPITE of unprecedented activity in nickel, copper, and base-metal mining in 1937, Canada's gold mines continued the most prosperous part of the industry, with a combined output estimated in value at $141,877,000. For the first ten months gold production amounted to 3,369,000 oz., 9.5 per cent over the figures for 1936. The value of Canada's entire mineral output exceeded that of 1936, the previous peak year, by 25 per cent, to reach $452,054,000.

An aggressive expansion program includes plans for more than 40 new mines to enter production in 1938. In output of nickel, platinum, and asbestos the Dominion leads all countries and ranks second in zinc and radium, third in copper and silver, and fourth in gold and lead.

Combined value of output from Canadian metal mines was $333,088,000 in 1937, a 28 per cent gain. The sixteen base-metal producers reporting in 1936 were joined by Waite Amulet and Normetal, in Quebec, operating at 850 tons daily, whereas in British Columbia the Allenby mine of Granby Consolidated resumed operations with its 3,500-ton mill; Base Metals Mining started its new 300-ton mill in November. Near Flin Flon, in northern Manitoba, the Sherritt Gordon began production in November at 1,500 tons daily. In the Portland Canal district of British Columbia the Big Missouri is preparing to operate a new 750-ton mill.

No previous year has equaled 1937 in production of gold, copper, lead, zinc, nickel, platinum metals, selenium, and tellurium. New output records were also set for non-metallics, including asbestos, sulphur, and salt, while structural materials registered 26 per cent advance.

With approximately 135 gold mines producing at the end of the year, Canada's annual gold output exceeded 4,000,000 oz. for the first time. Except Alberta and the Yukon, all provinces shared in it.

Nova Scotia, with 19 mines running mills, produced 19,542 oz., compared with 1,499 in 1933. Peak production was reached in 1898 with 31,000 oz. Outstanding among the properties contributing to this revival are Guysboro Mines, Montague Gold Mines, Seal Harbor Gold Mines, and those of the Consolidated Mining & Smelting Company in the Caribou and Salmon River districts.

In northwestern Quebec a rich mineral belt is being opened, extending more than 100 miles from the Ontario line to beyond Bell River. In 1936 there were 18 producing mines; 21 were operating in 1937, and approximately 30 will be milling or shipping ore in 1938, including new mills having a combined daily capacity of 1,300 tons. In the last ten years this district has produced more than 3,000,000 oz. of gold and more than 300,000 tons of blister copper. Quebec's output in 1937 is estimated at approximately $58,000,000. The Lamaque, at Bourlamaque, developed by Teck-Hughes, has assumed larger proportions than the parent mine in Kirkland Lake. Success in developing Quebec properties has also been had by Dome, McIntyre Porcupine, Ventures, and the Consolidated company. Johns-Manville and Asbestos Corporation produced more asbestos than in any other year, at 389,688 tons.

(Continued on page 54)

Table I—Canadian Mines Planning Production in 1938

Mining Property	District	Proposed Mill Capacity
ONTARIO		
Addington Mines (Rich Rock) (*a*)	Hastings	25
Algoma Ore Properties — Helen mine (*e*—siderite)	Michipicoten	2,000
Amca Mines	Garrison	75
Bilmac Gold Mines	West Shining Tree	100
Clark Gold Mines	Kenora	35
Cline Lake Gold Mines (O'Brien)	Goudreau	500
Cole Gold Mines	Red Lake	100
Elizabeth Gold Mining	Rainy Lake	25
Golden Summit	Kirkland Lake	25
Kirkland Gold Rand	Kirkland Lake	300
Kerr Addison Gold Mines	Larder Lake	500
Hallnor Mines	Porcupine	400
Lucky Kirkland Gold Mines	Kirkland Lake	25
MacLeod-Cockshutt Gold Mines	Little Long Lac	300
Madsen Red Lake Gold	Red Lake	250
Moneta Porcupine Mines	Porcupine	200
Preston East Dome	Porcupine	500
Sachigo River Exploration	Northern Patricia	....
Sand River Gold Mines	Beardmore	75
Sarmac Gold Mining Corp. (Dikdik)	Jellicoe	25
Shreiber Pyramid Gold Mines	Shreiber	50
Tombill Gold Mines (Newmont)	Little Long Lac	100
Vimy Gold Mines	Hislop	50
QUEBEC		
East Malartic Mines	Malartic	500
Francoeur Gold Mines	Rouyn	....
Halliwell Gold Mines	Rouyn	....
Lapa Cadillac Gold Mines	Cadillac	100
Pan Canadian Gold	Cadillac	250
Payore Gold Mines	Siscoe	100
Quebec Manitou Mines	Siscoe	....
Sladen-Malartic Mines	Malartic	250
Tiblemont Island Mining	Tiblemont	50
NOVA SCOTIA		
Manguma Belt Mines	Lunenburg	....
Renada Gold Mines	....	50
BRITISH COLUMBIA		
Abco Mines	Vancouver Island	50
B. C. Nickel Mines (*f*) (*d*)	Choate	500
B. R. X. Mines	Bridge River	100
Congress Gold Mines	Bridge River	100
Federal Gold Mines	Bridge River	100
Perrier Gold Mines	Nelson	50
Quesnell Quarts Mining	Hixon Creek	25
Salmo-Malartic Mines (*d*)	Sheep Creek	50
Silver Standard Mines (*b*)	New Hazelton	100
Utica Mines	Portland Canal	50
Big Missouri Mines Corp	Portland Canal	750

(*a*) Controlled by Consolidated Mining & Smelting Co. (*b*) Former producer. (*c*) Subsidiary of Proprietary Mines Ltd. (*d*) Base metals. (*e*) Controlled by Algoma Steel Corp.

Table II—Canadian Metal Mines Producing in 1937, with Proposed Increases in Milling Capacity

Mining Property	Gold Recovery Per Ton	Working Costs Per Ton	Tons Milled Daily, 1937	Mill Capacity, 1937	Date of First Production
ONTARIO					
Algold Mines	7.91	....	50	100	June, 1936
Algoma Summit Gold Mines	....	....	50	500	Mar., 1936
Argosy Gold Mines (Casey)	12.05	....	70	120	July, 1934
Bankfield Con. Gold Mines	14.18	8.37	100	120	May, 1937
Bidgood Con. Gold Mines	9.87	....	73	125	July, 1934
Buffalo Ankerite Gold (*)	8.57	4.53	744	1,000	June, 1926
Central Patricia Gold Mines	17.57	8.76	161	210	June, 1934
Coniaurum Gold Mines (*j*)	9.55	....	475	600	May, 1928
Darwin Gold Mines (Grace) (*b*)	16.35	....	48	60	Nov., 1935
Delnite Mines	5.14	....	....	200	June, 1937
Dome Mines	13.38	4.48	1,527	1,550	1910
Duport Mines (Cameron Is.) (*j*)	91.24	....	(*l*)	50	1935
Gillies Lake-Porcupine Mines	7.89	....	51	100	May, 1935
Gold Eagle Gold Mines	....	....	100	125	Oct., 1937
Gomak Mines (Porcupine Crown (*g*)	....	....	30	60	1936
Hard Rock Gold Mines	....	....	....	150	Dec. 1937
Hollinger Con. Gold Mines	8.61	5.56	4,837	5,000	1910
Howey Gold Mines	2.46	1.38	1,468	1,500	April, 1930
J-M Con. Mines (Jackson-Manion)	11.55	....	90	100	Aug. 1936
Kenland Gold Mines (Horseshoe) (*g*)	....	....	45	75	1936
Kenora Prospectors & Miners (*j*)	15.27	....	(*l*)	50	1935
Kirkland Lake Gold Mines	14.24	....	235	250	1919
Lake Shore Mines	17.48	5.62	2,445	2,500	1918
Lebel Oro Gold Mines (*b*)	6.47	....	....	100	May 1937
Leitch Gold Mines	17.13	13.08	....	100	Jan., 1937
Little Long Lac	15.58	9.72	232	300	Dec., 1934
Macassa Mines	16.07	....	196	300	Oct., 1933
Mace Gold Mines (Vipond)	4.66	4.23	290	300	1911
Matachewan Con. Mines (*j*)	5.47	....	329	400	Nov., 1934
McIntyre Porcupine Mines	9.44	....	2,394	2,500	1912
McLaren Porcupine Gold Mines (*g*)	6.40	....	(*l*)	25	July, 1935
McKenzie Red Lake Gold Mines	15.02	....	150	250	Mar., 1935
Minto Gold Mines (Jubilee)	2.26	3.17	110	115	June, 1931
Morris Kirkland Gold Mines	5.62	....	(*l*)	125	Oct., 1936
Naybob Gold Mines (*g*)	2.21	....	(*l*)	150	1935
New Golden Rose (*r*)	5.56	....	....	100	July, 1937
Northern Empire Mines (Newmont)	10.98	....	179	200	Mar., 1934
Omega Gold Mines (Castle-Trethewey)	4.71	3.46	(*l*)	500	1936
Pamour Porcupine Mines (*h*)	7.03	3.92	728	1,450	May, 1936
Parkhill Gold Mines	8.83	....	70	100	July, 1931
Paymaster Con. Mines (*b*)	7.67	....	393	525	Oct., 1934
Pickle Crow Gold Mines	23.53	....	144	400	April, 1935
Raven River Gold Mines (*b*)	18.29	....	....	60	Nov., 1937
Red Lake Gold Shore Mines	9.34	....	(*l*)	150	Aug., 1936
Ross (Hollinger)	10.84	....	75	100	Jan., 1936
Shenango Gold Mines (Oba) (*g*)	....	....	(*l*)	100	May, 1936
Stanley Gold Mines (*g*)	....	....	35	50	Nov., 1936
St. Anthony Gold Mines	11.36	5.36	90	200	Aug., 1927
Sturgeon River Gold Mines	15.49	....	....	95	Mar., 1937
Sylvanite Gold Mines	12.83	....	450	520	July, 1927
Tashota Goldfields (*v*)	9.50	....	50	90	April, 1935
Teck-Hughes Gold Mines	10.67	....	1,121	1,300	1917
Toburn Gold Mines (*i*)	26.27	....	100	150	April, 1913
Wendigo Gold Mines	11.73	8.04	60	100	Jan., 1936
Wright-Hargreaves Mines	17.87	6.78	1,102	1,200	May, 1921
Young-Davidson Mines (*z*)	3.23	2.21	924	1,000	Sept., 1934
International Nickel Co.	....	....	11,800	14,500	1916
Falconbridge Nickel Mines	....	....	1,200	1,250	Feb., 1930
M. J. O'Brien (Cobalt) (*t*)	....	....	(*l*)	250	
(Gowganda) (*t*)	....	....	(*l*)	80	
Chromium Mining & Smelting (*k*)	....	....	(*l*)	100	1935
Phoenix Molybdenite Corp. (*g*)	....	....	25	50	Aug., 1937
QUEBEC					
Aldermac Copper Corp. (*d*)	....	....	....	1,000	Jan., 1937
Arntfield Gold Mines	7.58	....	165	225	Aug., 1935
Beattie Gold Mines (*x*)	4.31	....	1,530	1,800	May, 1933
Canadian Malartic Gold Mines (*j*)	7.83	....	160	700	May, 1935
Cournor Mining (Bussieres) (*b*)	....	....	....	180	Sept., 1937
Belleterre Mines (McIntyre)	7.77	....	(*j*)	125	Aug., 1936
Jacola Gold Mines (Greene St.) (*a*)	....	....	70	100	Dec., 1933
Lamaque Gold Mines (Teck-Hughes)	13.34	....	250	1,100	April, 1935
Noranda Mines (*a*)	5.95	3.50	5,250	5,500	Dec., 1927
Normetal Mining Corp. (*e, f*)	....	....	....	500	Aug., 1937
McWatters Gold Mines	21.76	....	100	150	Sept., 1934
Molybdenite Corp. of Canada	....	....	....	30	1937
O'Brien Gold Mines	40.95	10.94	80	150	Sept., 1932
O'Neill Thompson Gold Mines (*g*)	....	....	25	35	Aug., 1936
Perron Gold Mines (Mathews)	8.14	....	170	350	1933
Powell Rouyn Gold Mines (*n*)	....	....	....	500	Dec., 1937
Randall Mines Corp.	....	....	....	120	Dec., 1936
Shawkey Gold Mining	11.10	....	135	180	Mar., 1936
Sigma Mines (Dome)	7.98	4.15	....	500	Mar., 1937
Siscoe Gold Mines	13.40	5.65	415	575	Jan., 1929
Stadacona Rouyn Mines	5.53	5.34	150	400	Oct., 1936
Sullivan Con. Mines	15.15	7.92	150	300	May, 1936
Thompson Cadillac Min. Corp.	5.08	....	70	215	June, 1936
Cons. Copper & Sulphur (Eustis) (*c, d*)	....	....	(*l*)	200	1865
Tetreault (*u*) (*b*)	....	....	(*l*)	500	1935
Waite Amulet Mines (*b, f*)	....	....	....	350	June, 1937
BRITISH COLUMBIA					
Ainsworth Mines (*t*)	....	....	....	....	Jan., 1937
Ashloo Gold Mines	....	....	(*l*)	25	July, 1936
Bralorne Mines (*q*)	16.08	....	475	550	Feb., 1932
Caribou Gold Quartz	12.80	....	110	225	Jan., 1933
Dawson Cons. Gold (*g*)	....	....	(*l*)	25	1936
Dentonia Mines (Durango) (*u*)	....	....	....	100	Dec., 1937
Dunwell Mines (Welldun Min. & Mill.)	....	....	(*l*)	40	May, 1934
Esperanza Mines	....	....	....	40	1937
Fairview Amal. Gold Mines	4.23	....	100	200	1936
Georgia River	....	....	....	25	1937
Gold Mountain (Hedley)	5.43	....	(*l*)	50	Dec., 1936
Grandoro Mines	....	....	(*l*)	40	1936
Grange Con. Mines (Pavilion Mt.) (*g*)	....	....	30	50	Oct., 1934
Grull-Wihksne Gold Mines (Bayonne)	23.64	....	....	50	Nov., 1936
Hedley Mascot Gold Mines (*a*) (*t*)	15.75	....	175	200	May, 1936
Highland-Bell (*t*)	....	....	(*l*)	....	1930
Island Mt. (Newmont)	14.20	....	119	155	Nov., 1934
Home Gold Mining	....	....	(*l*)	15	1936
Kamloops Homestake Mines (*u*) (*g*)	14.03	....	(*l*)	50	1936
Kelowna Exploration (Nickel Plate) (*s*)	....	....	200	225	1934
Kootenay Bell Gold Mines (*u*) (*b*)	....	....	50	115	Dec., 1934
Minto Gold (*g*)	....	....	70	125	Dec., 1934
Morning Star (Fairview)	....	....	30	75	Sept., 1935
Northern Mines	....	....	(*l*)	15	1936
Osoyoos Mines	16.45	....	(*l*)	125	Oct., 1935
Pioneer Gold of B. C.	14.49	5.98	350	400	1928
Precambrian Gold	....	....	(*l*)	30	1936
Relief-Arlington Mines (*i*)	14.34	....	40	75	1933
Reno Gold Mines	19.92	10.46	120	150	Aug., 1929
Reward Mining (Surf Point) (*b*)	12.34	....	....	25	Feb., 1937
Sheep Creek Gold Mines (Queens)	10.43	5.76	126	150	May, 1935
Silbak Premier Mines (*i*) (*m*)	....	....	400	600	1919
Superior (Providence) (*g*)	....	....	(*l*)	50	Oct., 1934
Surf Inlet Con. Gold Mines	15.89	....	30	400	April, 1936
Taylor Windfall Gold Mining	....	....	(*l*)	10	1936
Twin Lakes Gold	....	....	(*l*)	40	1936
Two Star	....	....	(*l*)	50	1935
Union Mining & Milling (Hecla)	....	....	(*l*)	200	1933
Vidette Gold Mines (*a*)	....	....	35	80	Dec., 1935
Velvet Gold Mining (*a*)	....	....	(*l*)	100	1932
Wayside Con. Gold (shut down)	....	....	25	150	Nov., 1934
Windpass Gold	....	....	40	50	Jan., 1934
Wesko Mines (Central Star) (*u*)	7.89	6.02	90	100	Nov., 1936
Wilcox Mining Synd. (*u*)	16.50	....	12	20	1934
Ymir Con. Gold (Goodenough) (*u*)	....	....	30	100	July, 1935
Ymir Yankee Girl Gold Mines (*u*)	10.03	....	150	150	July, 1934
Cons. Min. & Sm. (Kimberley) (*p*)	....	....	....	6,600	1906
Cons. Min. & Sm. (Tadanac) (*a*) (*y*)	....	....	....	2,400	1906
Britannia Min. & Sm. (*a*) (*p*) (*w*)	....	....	....	6,000	1903
Base Metals Mining Corp. (*b*) (*p*) (*e*)	....	....	....	300	Nov., 1937
Granby Con. Mines (Allenby) (*b*) (*a*)	....	....	....	3,500	June, 1937
Noble Five Mines (Slocan) (*u*) (*b*)	....	....	....	100	Aug., 1935
NOVA SCOTIA					
Avon Gold (Oldham)	....	....	5	100	May, 1936
Caribou (*r*)	....	....	20	20	1934
Guysborough Mines (*j*)	....	....	75	100	1934
Lacey (Gold River)	....	....	25	35	1934
Mineral Industries (Wine Harbor)	....	....	....	75	May, 1937
Montague Gold (*v*)	....	....	60	75	1933
Nova Scotia Gold (Tangier)	....	....	(*l*)	20	1936
Nugold Mining Corp. (Blockhouse Dome)	....	....	....	25	Jan., 1937
Queens Mining	....	....	20	50	1935
Seal Harbor Gold Mines	....	....	(*l*)	200	Aug., 1936
United Gold-fields (Brookfield)	....	....	25	25	Feb., 1934
Stirling Mines (British Metal Corp.) (*a*) (*u*)	....	....	(*l*)	260	Dec., 1935
Waverley Con. Mines (Lake Thomas) (*b*)	....	....	....	75	1937
MANITOBA					
God's Lake Gold Mines	9.24	8.61	151	200	Sept., 1935
Gunnar Gold Mines	11.60	....	134	150	April, 1936
Laguna Gold Mines (Rex) (*e*)	17.81	....	75	90	Aug., 1936
Gurney Gold Mines (Wylie-Dominion)	8.75	....	....	125	Oct., 1937
San Antonio Gold Mines	8.85	....	300	300	July, 1932
Hudson Bay Min. & Smelt. (Flin Flon) (*p*) (*f*)	....	....	4,500	4,600	Sept., 1930
Sherritt Gordon Mines (*b*) (*f*)	....	....	....	1,500	Aug., 1937
ALBERTA					
Athona Mines	....	....	(*l*)	15	1936
Lake Athabaska, Box mine (*r*)	....	....	100	1,000	1936
NORTHWEST TERRITORIES					
Eldorado Gold (pitchblende-silver) (*o*)	....	....	75	150	1933
Bear Exploration & Radium (*t*)	....	....	35	35	Oct., 1935

(*a*) Copper-gold producer. (*b*) Former producer. (*c*) Continuous operation since 1879. (*d*) Shipping copper and sulphur concentrates. (*e*) Controlled by Mining Corp. of Canada. (*f*) Copper-zinc-silver producer. (*g*) Production temporarily suspended. (*h*) Controlled by Noranda Mines. (*i*) Controlled by Premier Gold Mining, one of the principal foreign development companies of A. S. & R. (*j*) Controlled by Ventures, Ltd. (*k*) A fourth furnace added to Sault Ste. Marie smelter in 1936, where concentrates are treated. (*l*) Not reported. (*m*) Company controls 5 mines in Portland Canal area, including the Premier, Canada's second largest silver producer. (*n*) Shipping to Noranda smelter. (*o*) Monthly output approx. 80,000 oz. silver; 3 grams radium; 296 tons of concentrates in 1935, 401.5 tons in 1936, 294 tons in first 5 months of 1937. (*p*) Silver-lead-zinc producer. (*q*) Also treating ore from Bradian mine. (*r*) Controlled by Con. Mining & Smelting. (*s*) Formerly largest B. C. gold producer. (*t*) Silver producer. (*u*) Gold-silver-lead-zinc producer. (*v*) Controlled by Minefinders, Ltd. (*w*) Controlled by Howe Sound. (*x*) Controlled by Nipissing Mines. (*y*) At Trail are located customs concentrator, zinc production plant and refinery, copper smelter and refinery, lead smelter and refinery, fertilizer plant, etc. (*z*) Subsidiary of Hollinger Gold Mines. (*) Combined with Marbuan, formerly March Gold Mines.

Table III—Cumulative Dividend Record of Canadian Metal Mines (a)

Province and District	1933	1934	1935	1936	1937	Total to End of 1937
ONTARIO:						
Sudbury	$2,746,509	$10,125,156	$13,866,659	$21,886,752	$35,749,207	$229,718,129
Cobalt (c)	97,769	245,790	150,000	600,000	444,000	106,982,442
Porcupine	7,536,827	11,910,041	9,952,883	11,021,672	12,169,765	145,121,014
Kirkland Lake	10,561,762	13,930,381	14,584,641	16,989,780	20,259,948	121,016,027
Patricia	.....	500,000	420,500	1,652,900	2,714,950	5,298,350
BRITISH COLUMBIA	$3,075,572	$6,762,820	$11,147,258	$16,752,748	$16,819,866	$172,916,393
QUEBEC	4,004,203	5,255,505	5,544,898	8,114,999	8,951,830	41,651,685
MANITOBA	.....	112,023	3,228,734	3,082,517	5,230,358	11,653,631
NOVA SCOTIA (b)	.....	.....	.....	.....	.....	47,928
MISCELLANEOUS	.....	529,138	568,818	1,011,560	1,579,548	3,689,064
Totals	$27,922,642	$49,470,854	$59,364,889	$81,112,968	$103,949,472	$838,094,663

(a) Data compiled by *Northern Miner*. (b) Paid in 1900; dividend record incomplete.
(c) Since 1933, paid by Nipissing Mines, a holding company.

Canada

(Continued from page 52)

Important expansion has taken place in several districts of Ontario. In the 60-mile belt west from Little Long Lac to Lake Nipigon, nine properties have been brought into production since Little Long Lac mine was found six years ago. The first two mills were built in 1934, four more in 1937, and three are now nearing completion. Their combined output is estimated at $7,000,000 for 1938.

Larder Lake camp stretches east from Kirkland Lake to the Quebec boundary, centering around the Kerr-Addison, where large orebodies occur in carbonate formation. Important gold deposition has been found on the Barber-Larder property and at the old Argonaut, now controlled by Beaverhouse Lake Gold Mines. At Larder Lake, Omega Gold Mines is producing 500 tons per day and Raven River Gold Mines have a 50-ton mill. Another 500-ton mill is being built and there are prospects for adding to the number of producers within the next year or two. In the province 64 gold mines are expected to be producing before the end of 1938 with a combined daily capacity of 25,850 tons. In 1937, 48 gold mills were in operation.

Ontario is also the largest copper-producing province, the Sudbury nickel-copper ores being the source of 62 per cent of Canada's total for 1937, amounting to 539,810,451 lb. The combined output of nickel from International Nickel and Falconbridge was 219,878,212 lb., up from 169,739,393 lb. the previous year. The Ontario Refining Company, International Nickel's subsidiary at Copper Cliff, produced in 1937 more byproduct selenium and tellurium than in any other year.

In Northwest Territories, the concentrator at Canada's farthest north mine, operated at Great Bear Lake by Eldorado Gold Mines, treated 23,000 tons of ore, with an output valued at $1,250,000. Development was started five years ago and underground operations have been carried to a depth of 590 ft. and mill capacity has been doubled. Concentrates are shipped 4,000 miles to Port Hope, Ont. In 1937 the refinery was enlarged to a capacity of 100 grams of radium a year.

Near the boom town of Goldfields, on Lake Athabaska, 500 miles south of Great Bear Lake, the Consolidated Mining & Smelting Company is developing the Box property. Plans call for building a 1,000-ton mill and a hydro-electric plant capable of supplying 6,000 hp. before the end of 1938. During the past summer 20,000 tons of freight was shipped from the nearest railhead at Waterways, Alberta. Throughout the season fourteen commercial planes have been in service.

The same company and the Mining Corporation of Canada and the Howey Gold Mines, Ltd., are among the important operators active in the Great Slave Lake area, Northwest Territories, including the Yellow Knife River. Claims have been staked for 30 miles on either side of this river above its outlet into the lake; shafts have been sunk and underground work has been done on two properties. The Hump vein, on the Gordon Lake claims of the Mining Corporation, is one of the richest concentrations of gold ore known in Canada. It is near the Yellow Knife River and north of Great Slave Lake. Official reports describe the vein as associated with a drag fold. Surface assays average $110 per ton and shallow drill holes give $56 across 7.7 ft. for a 200 ft. length. At 280 ft. the vein showed a width of 20 ft., samples returning 8.58 oz. to the ton.

Metals of the platinum group derived from the Sudbury nickel-copper ores in 1937 are valued at $9,934,000 for 1937, compared with $7,803,806 in 1936. Cadmium was produced from the smelters at Flin Flon, Manitoba, and Trail, B.C., which also turned out bismuth and arsenic. Consolidated's Sullivan mine was the greatest single source of silver in 1937. Of the Dominion's output of silver, 49 per cent was recovered in British Columbia.

In the non-metallics division, the Asbestos Corporation and Johns-Manville sold asbestos valued at $14,072,000. Gypsum production totaled 1,020,587 tons valued at $1,516,000, compared with $1,278,971 in 1936.

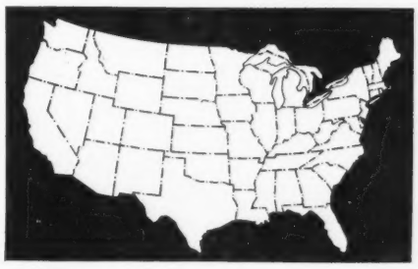
The dividend record of Canada's mining industry in 1937 jumped to $104,000,00 from $81,112,968 in 1936, and included distribution of profits from 51 mining companies. Seven companies paid their initial dividend and increases were made by 26. Compared with the record for 1936, the dividend total increased 34 per cent. International Nickel, Canada's greatest industrial enterprise, again overshadowed all other dividend payments, with shareholders receiving $34,747,955. Lake Shore's annual distribution increased 20 per cent to $12,000,000, followed by $11,420,447 paid by Consolidated Mining & Smelting. Noranda and Hudson Bay both made substantial increases, at $7,279,259 and $4,826,453, respectively. Hollinger's distribution fell off to $4,920,000, but Dome and Wright-Hargreaves were well ahead of last year, with $4,380,003 and $3,850,000, respectively. Falconbridge Nickel and McIntyre Porcupine maintained the 1936 rate at $1,001,252 and $1,596,000, respectively. Howe Sound, Pickle Crow, Siscoe Gold and Teck-Hughes all exceeded last year's record, with respective payments of $2,842,746, $1,050,000, $1,020,814 and $2,403,572.

United States

Metal mining reaches highest activity since depression. Industry, however, is compelled to curtail output toward end of year

H. C. Chellson

Assistant Editor



OPERATORS of large and small mines had early confidence that 1937 would prove to be a good year for non-ferrous metals. It was. None in the industry, however, foresaw that certain governments would announce firmer views on rearmament and that consequent speculation abroad would influence higher metal prices here. Neither did they expect that consumers in this country would be forced into making unusually large purchases of metals because of rising prices, greater industrial recovery, threats of labor strife, and fears of inflation. Adding to the general excitement, Nature spread a drought in the Northwest, reducing water for hydro-electric power used in making electrolytic zinc that was in urgent demand by consumers. Heavy buying in the spring quickly reduced metal stocks, and mine operators, apprehensive of the rapid upswing, increased production during the summer to fill depleted supplies.

Wages and employment increased. According to the Bureau of Labor Statistics, using 100 as the 1929 basis, employment in the metal mining industry reached 84.1 in September, compared to the high of 64.4 in 1936. Payrolls in August reached 83 per cent of the 1929 basis, compared to the high of 57.7 per cent in December, 1936. In the fall, producers witnessed a sharp falling off in demand for base metals, and realized that if the high rate of production continued, the industry would be burdened with unwieldy stocks. Leading interests, therefore, announced sharp views on curtailment in copper for the last quarter. Lead and zinc curtailment followed. Employment and wages decreased along with falling metal prices, and at the close of the year silver producers received a jolt. President Roosevelt, by proclamation signed on Dec. 30, announced that silver was reduced from 77.57c. to 64.64c. per ounce. At the close of 1937 some mine operators were apprehensive about the immediate future, but most of the industry believes general business will gradually show improvement during the last six months of the current year, and prospects for such an outlook are held to be improving for the mining industry. Outstanding events of the leading mining states described herewith, indicate the tempo of mining operations in 1937. Statistics by the Bureau of Mines show that 1937 could, perhaps, be called a boom year which mine operators had not anticipated.

Arizona—Gold and silver production in 1937 surpassed any previous record of the State, and copper output was the greatest since 1930. Gold recovered in placers decreased, whereas output from lode mines increased. Leading gold producers were United Verde, at Jerome; Copper Queen mine, Bisbee; and New Cornelia mine, at Ajo, where gold is recovered in copper ore. Other gold producers were the Gold Road, Tom Reed, Gold Standard, Tennessee-Schuylkill, Octave, Magma, Hillside, Eagle-Pitcher, Mammoth-St. Anthony, Denn, Iron King, Lake Superior & Arizona, New Year Mohawk, and Pilgrim mines.

About 5,900,000 oz. of silver were recovered in the Bisbee, Jerome, Ajo, and Superior copper-mining districts, with a large volume also recovered from zinc-lead ores mined in the Oro Blanco, Wallapai, Ash Peak, Pioneer, and Tip Top districts.

Copper mines responsible for most of the output were New Cornelia mine, of the Phelps Dodge Corporation; Inspiration mine, at Inspiration; the Copper Queen, at Bisbee; United Verde mine, at Jerome; Miami mine, at Miami; and the Magma mine, near Superior. Operations at Ray by the Nevada Consolidated Copper Corporation were resumed in April following a four-year shutdown. Christmas Copper Company, near Winkelman, reopened, and the American Smelting & Refining Company again started the Swansea mine, in Yuma County. Smelters that resumed operations during the year were the Hayden smelter of American Smelting & Refining Company and the one at Clifton of the Phelps Dodge Corporation, which resumed after a five-year shutdown. In May this company announced a program of capital expenditures over the next five years involving $40,000,000 for various purposes which include opening and equipping the Clay orebody, at Morenci, estimated to contain 245,000,000 tons of ore having an average copper content of 1.12 per cent.

Practically all large copper producers in the State were forced to curtail output sharply in the last quarter, due to the recession.

Higher lead production during the year came from the Montana mine, at Ruby, of the Eagle-Pitcher Mining & Smelting Company, and the Tennessee-Schuylkill property at Chloride, Mohave County.

Three properties in the State were chiefly responsible for the zinc production—the Montana, at Ruby; Tennessee-Schuylkill, and the "79" mine, near Hayden Junction.

Tungsten and molybdenum properties in the State underwent greater development, with consequent increased production.

Utah—Gold production in the State made a new high in 1937, totaling about 327,000 oz., compared to 223,440 oz. in 1936. The Bingham district accounted for about 74 per cent of the total. Most of the increase was derived from the high rate of copper production by the Utah Copper Company. Other important producers were the United States & Lark, Eureka Standard, Mammoth, and Con-Mercur mines. Production at Bingham by the Utah-Delaware & Utah-Apex properties also increased. These mines were consolidated in 1937 and are operated by the National Tunnel & Mines Company, a subsidiary of the International Smelting & Refining Company. A 23,000-ft. tunnel is now under construction by the company, whose objective is to open the Utah-Delaware and the Utah-Apex mines in considerable depth.

Utah's silver production in 1937

was 12,844,000 oz., second to that of Idaho. Leading producers were the United States & Lark, at Bingham; the Tintic Standard, at Dividend; the Utah Copper mine, at Bingham; and the Silver King Coalition, at Park City.

Mining the largest volume in its history, Utah Copper removed 23,000,000 tons of ore in 1937. Output of copper, therefore, was the largest in the history of the State. The Arthur and Magna mills of the company have a combined capacity of treating 80,000 tons of ore a day, and during 1937 substantial quantities of molybdenum were recovered in the plants.

The United States & Lark, Silver King Coalition, and Park Utah Consolidated properties were again the leading lead producers. It is estimated that about 80 per cent of the lead produced came from complex zinc-lead-iron ores treated in flotation plants at Midvale, Park City, Tooele, and Bauer.

Montana—Drought in 1937 was responsible for the lower production of silver, zinc, and lead in the State. Deficient hydro-electric power during the summer reduced operations in the Great Falls and Anaconda electrolytic zinc plants of the Anaconda Copper Mining Company, and mines in Utah and Nevada were affected because their zinc concentrates, shipped to plants mentioned, could not be treated. Water for concentrating purposes was reduced and wells had to be dug to relieve the situation. Use of electrical energy was curtailed and old steam plants and steam locomotives were pressed into service, until rain and snow finally fell and eased the situation in early fall. A new hydro-electric plant at Polson, on the Flathead River, is expected to be ready in June, 1938, with a capacity of 56,000,000 kw. Therefore, a recurrence of last summer's severe experience is not expected.

Gold recovered in placers declined, due to the drought. Lode mines, therefore, accounted for the higher output in 1937. The Anaconda Copper Mining Company, at Butte, was the largest gold producer. Other lode mines reporting increases were Ermont mine, in Beaverhead County; the Ruby Gulch, Phillips County; Jardine, Park County; and West Mayflower, in Madison County. Small gold mines also had increases, but small placer operations continued to decline.

Silver, recovered in zinc-lead ore principally from the Butte district, showed a decrease of more than 1,100,000 oz. according to the Bureau of Mines. Silver from copper ore, however, increased nearly 990,000 oz. About 70 per cent of Montana's silver was produced from the Butte district, principally from mines of the Anaconda Copper Mining Company. Other sources were the Trout, Granite, Bimetallic, Silver Prince, and Two Percent mines, in the Philipsburg district.

Copper production from mines of Anaconda Copper showed a substantial increase over the record for 1936, but the general business recession necessitated a sharp curtailment during the last quarter. Output in the State was about 143,765 tons of copper, 34,221 tons above the 1936 figures.

Lead production declined from 19,059 tons in 1936 to 18,685 tons last year. Shortage of electrical power was responsible for the decrease.

Zinc output suffered the sharpest decline, due to the power shortage at the electrolytic zinc refineries of the Anaconda Copper Mining Company. Production was suspended at the largest zinc-lead mine, the Orphan Girl, in June, and output at the Emma mine was curtailed. Production of zinc fell 10,690 tons of metal, from 49,717 tons in 1936.

California—Not since 1883 did California produce as much gold as in 1937, the total being 1,164,400 oz., compared to 1,077,442 oz. in 1936. Throughout the gold lode mining districts, there were additions to mining and milling equipment, and with reasonable assurance that gold would continue at $35 an ounce through the year, old producing mines reopened and prospects of merit attracted capital for development, with consequent new production. The leading gold producer was the Empire Star Mines Company, Ltd., with mines in the Grass Valley-Nevada City district, in Nevada County, and the Pennsylvania mine, in Yuba County. The Idaho Maryland Mines Corporation, with properties in Nevada and Butte County, also accounts for a substantial portion of the year's gold output. Lava Cap Gold Mining Corporation, Bradley Mining Company, and Golden Center mine, also in Nevada, were important producers.

Among the major gold-dredging operations were the Yuba Consolidated Gold Fields, in Yuba County; the Natomas Company, Capital Dredging Company, and Cosumnes Gold Dredging Company, in Sacramento County. Good production came from bucket-type dredges operating in Merced and Stanislaus, Siskeyou, Amador, and Calaveras counties. Dragline dredges were more numerous in 1937 and successful operations were reported. The Bureau of Mines reports there were several thousand gold producers in California, and in addition to lode, bucket dredge, and dragline-dredge types of mining, gold also came from dry-land dredging, hydraulicking, and small-scale hand methods of placer mining.

Opening by Walker Mining Company of the company's copper mine in 1937 contributed to silver output that was recovered as a byproduct. The bulk of the State's silver production, however, came from mines of the Sierra Consolidated Mines, Inc., and the Golden Queen Mining Company, in Mono County and Kern County, respectively.

Idaho—The country's leading silver State broke a record in silver, producing 19,500,000 oz. in 1937, or about 5,000,000 oz. above the 1936 production. Records of the Bureau of Mines show 399,046,495 oz. silver has been produced from mines in this State from 1863 to 1937. Another record for the State was zinc output, 53,500 tons in 1937. Increased milling capacity at the Sunshine mine throughout

Principal United States Production of Gold, Silver, Copper, Lead and Zinc

(United States Bureau of Mines)

Mine production of metals in 1936 and 1937 in terms of the recovered and recoverable metal in ounces and short tons. Figures for 1937 estimated.

Western States	Gold, Oz.		Silver, Oz.		Copper, Tons		Lead, Tons		Zinc, Tons	
	1936	1937	1936	1937	1936	1937	1936	1937	1936	1937
Arizona	322,408	338,500	8,386,043	9,000,000	211,275	284,250	10,688	12,500	3,589	5,000
California	1,077,442	1,164,400	2,103,799	2,865,000	4,381	5,240	482	1,250	8	.....
Colorado	366,607	367,554	5,902,776	6,095,195	8,865	10,835	7,267	9,069	1,172	3,993
Idaho	80,291	78,000	14,537,530	19,500,000	1,477	2,150	91,339	102,800	49,100	53,500
Montana	180,209	203,400	11,600,563	11,540,000	109,544	143,765	19,059	18,685	49,717	39,027
Nevada	286,370	276,100	5,068,786	4,536,000	70,696	76,885	10,712	8,750	13,477	12,185
New Mexico	33,037	41,125	1,163,255	1,263,420	3,166	31,279	6,626	7,085	20,668	24,185
Oregon	60,753	52,700	85,061	66,400	287	460	79	125	61	29
South Dakota	586,353	582,000	144,448	143,000	.....	.....	.....	.....	.....	.....
Texas	613	550	1,361,459	1,303,000	27	140	468	398	.....	.....
Utah	223,444	327,000	9,997,645	12,844,000	126,217	205,770	69,886	88,397	36,192	47,527
Washington	12,217	31,600	66,900	100,000	102	75	840	2,925	4,403	4,386
Wyoming	1,964	1,768	1,113	199	.....	.....	.....	.....	.....	.....
Alaska, Central and Eastern States	550,957	593,187	676,442	953,399	74,212	81,970	155,473	206,205	397,187	428,710
Totals	4,382,804	4,752,801	61,563,892	70,838,514	610,249	842,820	372,919	458,190	575,574	618,550

United States

1937 accounted for the 12,209,000 oz. of silver produced from this silver deposit. Polaris Mining Company completed a new 250-ton flotation plant and commenced operation in 1937, as did Sullivan Mining, which treated lead-zinc ore in its new 750-ton plant.

Gold production also increased, chiefly accounted for by ten floating-bucket dredges, compared to twelve in 1936. The Boise Basin district, supporting the leading gold placer and lode mining operations, was responsible for about one-third of the total gold output.

Three properties accounted for about 76 per cent of the total lead output. The Bunker Hill & Sullivan Mining & Concentration Company, and the Morning and Hecla mines. Producers accounting for most of the remainder were the Page, Triumph, Star, Sherman, Gold Hunter, Sidney, and Blackhawk properties.

The Bureau of Mines states that about 82 per cent of Idaho's zinc produced in 1937 was from zinc-lead ore from the Morning, Bunker Hill & Sullivan, Star, and Triumph mines. Most of the State's precious and base-metal production comes from mines in the Cour d'Alene region, in Shoshone County. Copper was derived principally as a byproduct from silver ore produced at the Sunshine, Polaris, and Crescent mines, and in lead-zinc ore from Bunker Hill & Sullivan, and Morning mine and lead ore from the Hecla mine.

Nevada—Gold, silver, lead, and zinc production declined in 1937 compared with 1936, but the value of metals produced increased 18 per cent. Interesting figures of mining recovery in the State are reflected by the value of mineral output in 1932 as $5,067,-171, compared to $34,540,326 in 1937. Comparing 1937 to 1936 shows gold production decreased 4 per cent, silver 11 per cent, copper output increased 9 per cent, and lead and zinc production declined 18 and 10 per cent respectively.

The principal producer of gold was Nevada Consolidated Copper Corporation, operating in the Robinson district, near Ely. Weepah Nevada Mining Company, in Esmeralda County, and the Consolidated Coppermines Corporation were the next largest gold producers. The Goldfield district was active throughout 1937, with operations by the Goldfield Consolidated Mines Company, Bradshaw Syndicate, and the Eastern Exploration Company, a subsidiary of the Calumet & Hecla Consolidated Copper Company, and smaller operators. On the Comstock lode the Dayton Consolidated Mines Company, Arizona Comstock Corporation, and Consolidated Chollar, Gould & Savage Mining Company were the principal producers.

Though the price of silver was maintained at 77¢ during the year, silver output declined. The reduction is accounted for, however, by the exhaustion of known orebodies in the Tybo mine of the Treadwell Yukon Company, Ltd., which heretofore was one of the largest silver producers in the State. There were many small mines operating throughout the State, but most of the silver was produced in the Pioche district. Electrical power from Boulder Dam was supplied this growing region on Sept. 1.

In 1937 the Nevada Consolidated Copper Corporation produced about three-fifths of the State's copper. Consolidated Coppermines Corporation resumed operations at its open-cut mine. The long-standing litigation between the company and the Kennecott Copper Corporation was settled on July 20, which enabled Coppermines to double its capacity to 6,000 tons of ore daily. Mountain City Copper Company, a subsidiary of the International Smelting Company, operated the Rio Tinto mine, producing a substantial quantity of copper.

Most of the lead was produced in the Pioche district by the Combined Metals Reduction Company. The sharp decline in the State's output was due to abandonment of the Tybo mine, previously mentioned. Zinc output was provided principally by the Combined Metals Reduction Company. Closing of the Tybo mine also was responsible for a drop in total output for the State during 1937.

Colorado—An estimate has been made that the combined output of manganese, molybdenum, tungsten, and vanadium in 1937 had a gross value equiva'ent to nearly three-fourths of the combined value of the State's production of gold, silver, copper, lead, and zinc. The total value for precious and base metals for 1937 was $21,850,991.

Most of the gold was produced in the Cripple Creek district, with practically all the ore from the district treated in the Golden Cycle mill. The largest producers in this district are the Cresson, United Gold Mines, Golden Cycle-Ajax, Stratten Estate, and several other smaller mines. Mines in Park County were also substantial gold producers, such as London Gold Mines & Milling Company, Fairplay Gold Mines Company, and London Butte Gold Mining Company.

Silver production from Eagle County was the highest in the State, with production coming chiefly from the Empire Zinc Company. The Shenandoah-Dives Mining Company, near Silverton, in San Juan County, was also an important producer, treating silver-gold ore. This company completed the 3,200 ft. crosscut to the Silver Lake group of claims owned by American Smelting & Refining Company, and the Silver Lake vein was cut about 900 ft. below the old working.

Mines of the Empire Zinc Company, in Eagle County, were the largest producers of copper. The zinc-lead orebodies of the company have not exploited since December, 1931.

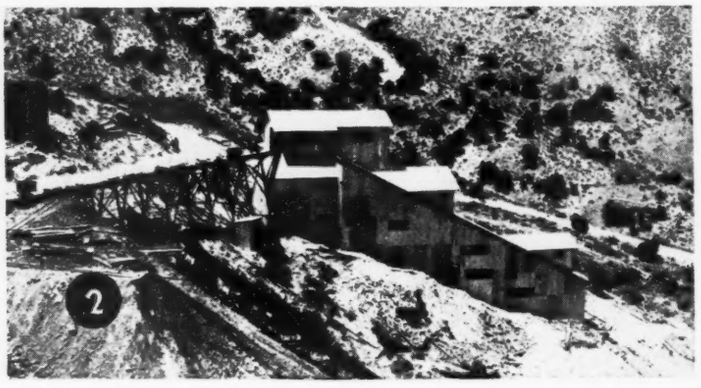
San Juan County was the largest provider of lead during 1937. Lead-zinc mines in the district shipped their ore to the custom mill of the Shenandoah-Dives company, near Silverton, for concentration. During the summer, the Sunnyside mine, at Eureka, controlled by the United States Smelting, Refining & Mining Company, was reopened following a shutdown since September, 1930. Operations did not reach the full capacity at the 1,000-ton mill, but production during the year did account for higher output of gold, silver, copper, lead, and zinc from San Juan County.

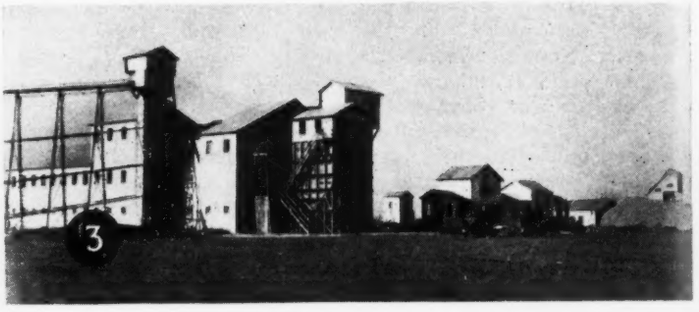
The Climax Molybdenum Company, at Climax, operated its flotation plant every day of the year, treating an average of 9,400 tons of ore daily, and produced 23,600,000 lb. of elemental molybdenum.

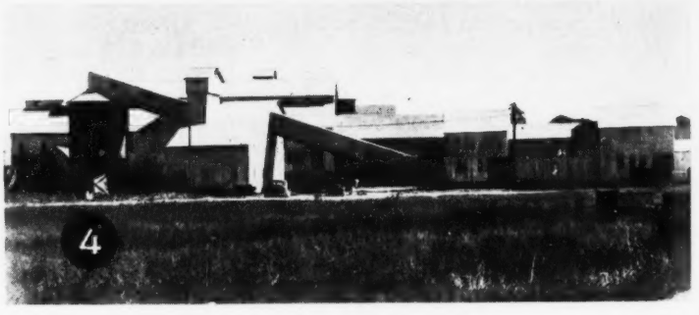
New Mexico—Mineral output in this State increased greatly during 1937, and major activity was principally confined to copper production. Expanded operations by the larger metal producers, however, also accounted for the general increase. The Chino Mines of the Nevada Consolidated Corporation, at Santa Rita, maintained output at about 9,000 tons of ore daily, treated at the mill at Hurley. A copper smelter is under construction by the company at Hurley, where operations are planned to start late in 1938 or early 1939. The 250-ton mill of the Black Hawk Consolidated Mining Company treated zinc-lead-copper-silver custom ore as well as the company's own output. The Hanover mine reopened its zinc-lead property, and milling started in May. The Pecos mine of the American Metal Company continued operations.

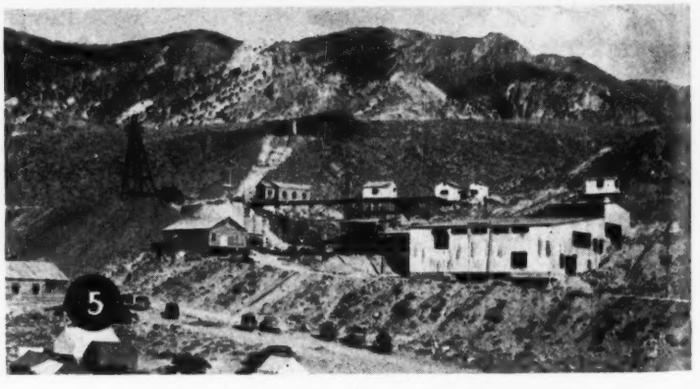
Washington—Mines chiefly responsible for the greater output in gold were Republic, Azurite, and Orient. The Republic, operated by Knob Hill Mines, started operations of a 400-ton mill in June, 1937. A new cyanide mill was completed at the First Thought mine during 1937. During 1938 copper production will start from a 1,000-ton mill at the Holden property by the Chelan Lake Division of the Howe Sound Company. Lead and zinc production gained at the Pend Oreille Mines & Metal Company and Metaline Mining & Leasing Company.

Some NEW MILLS *of* 1937









1 HOWE SOUND'S MILL, in the Chelan district, Washington. This 1,000-ton flotation plant has been built to treat the gold-copper ore of the Holden mine, discovered about 40 years ago. Details of the enterprise are given in the January, 1938, number

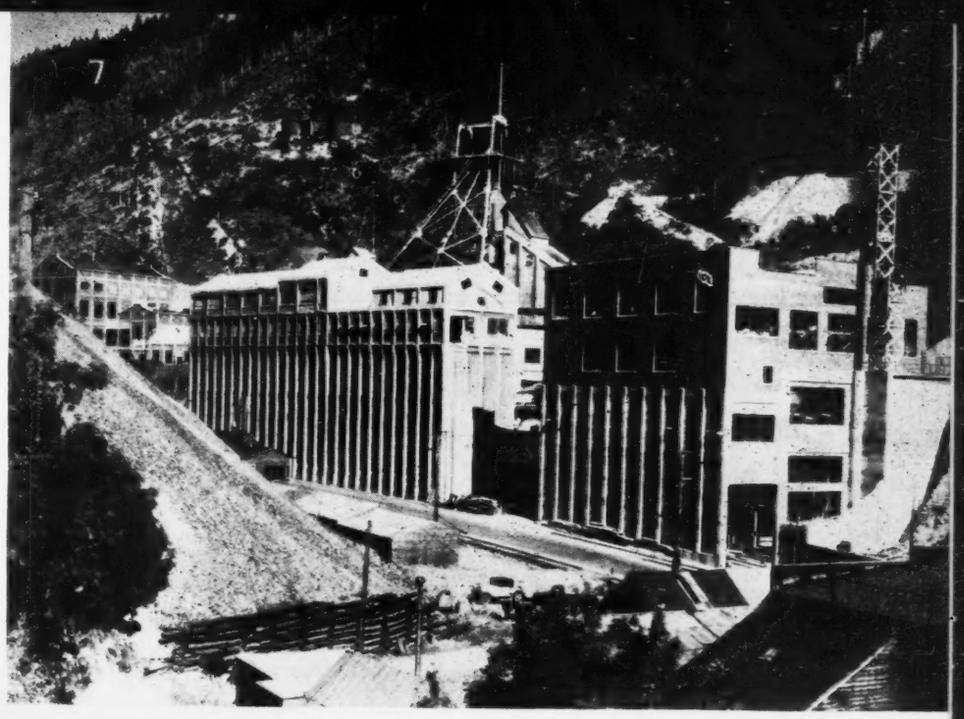
2 LAKESIDE MONARCH flotation plant, of 100 tons' capacity and situated on the west shore of Great Salt Lake, 70 miles west of Salt Lake City. It was started Aug. 14 and closed a few weeks later for modification of the flowsheet. It will be re-started soon. The view is taken looking west

3 THE NEW WACO MILL of St. Louis Smelting & Refining Company, 1¼ miles west of Waco, Mo., in Kansas. This Tri-State plant was nearly completed in 1937 and will be started in the spring. It uses jigs, tables, and flotation and has a capacity of 50 tons per hour

4 A NEW CENTRAL MILL, shown here, was built in the Tri-State district. It is the Gordon concentrator of the Federal Mining & Smelting Company, in the northwest part of Picher, Okla. It treats mine ore from 11 shafts and has a capacity of 75 tons per hour. It began running in November.

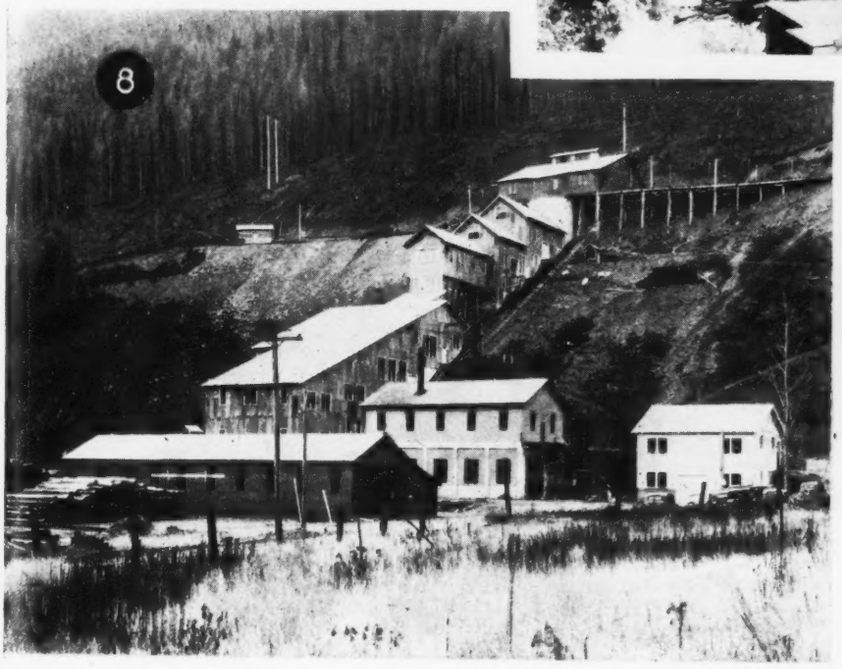
5 DESERT SILVER, Inc., installed this 200-ton cyanide mill at its Nivloc mine, at Silver Peak, Nev. The plant was started Oct. 1, 114 days after the construction contract was let. It recovers 85 to 90 per cent of the silver from an ore averaging 16 oz. and a small amount of gold

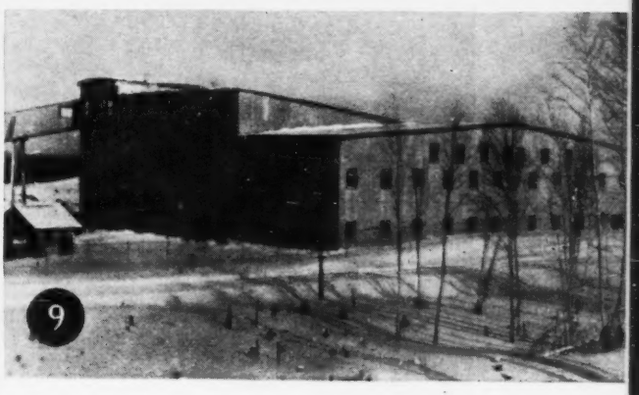
6 A 300-TON CYANIDE PLANT, here seen in left center, was completed by the Weepah Nevada Mining Company, in the Weepah district, Nevada, and put in operation March 9, replacing flotation previously employed. A countercurrent flowsheet is used



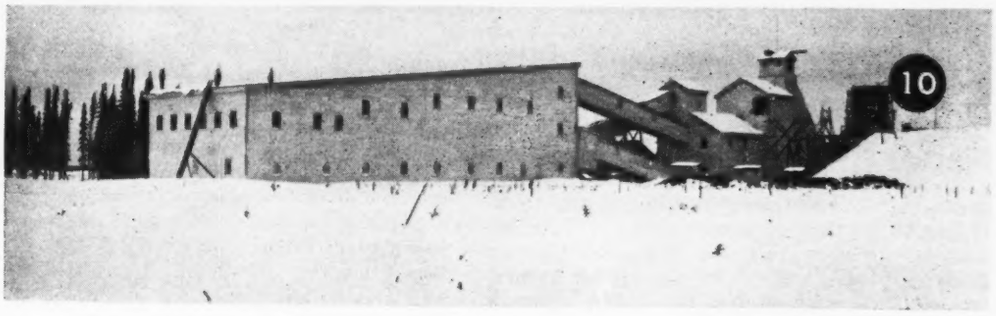
7 THE SULLIVAN MINING COMPANY'S new 750-ton flotation plant, at Burke, Idaho, in the Coeur d'Alenes, for treating ore from the Star mine, was started Aug. 1. The lead-silver-zinc ore is ground in ball mills, operating in closed circuit with submerged spiral classifiers, and concentrated by flotation. The mill is at the right of the picture. On its left is the Hecla sorting plant with the Hecla ore bins and the Star storage bins

8 ANOTHER COEUR d'ALENE MILL is the new flotation plant of the Polaris company, subsidiary of Hecla Mining Company. It began operation June 1. Its crushing section can handle 80 tons of ore per hour, or, on one shift, enough to supply the concentrator, when enlarged, for 24 hours





9 SIGMA MINES, operating in the Harricanaw district, Quebec, and a subsidiary of Dome Mines, Ltd., placed this 500-ton cyanide plant in commission March 17. Grinding is done in solution and is followed by thickening, agitation, secondary thickening, double filtration, and precipitation



10 250-TON CYANIDE PLANT installed by Sladen-Malartic Mines, Ltd., at Malartic, in northwestern Quebec. It was nearly complete at the year end. Two-stage crushing is followed by single-stage grinding in solution in closed circuit with a spiral classifier, primary thickening, agitation, secondary thickening, and filtration

11 DELNITE MINES, Ltd., subsidiary of Sylvanite Gold Mines, Ltd., of Kirkland Lake, Ont., erected this cyanide plant in the Porcupine district, starting it June 1. Capacity has been increased from an initial 100 tons per day to over 200. Thickening is followed by four stages of agitation with double filtration and Merrill-Crowe precipitation

The Philippines

Year prosperous, with gold output higher. Possibility of interference by Government disturbing. Outlook otherwise bright

Ralph Keeler
Manila, P. I.

THE MINING INDUSTRY of the Philippine Islands prospered in 1937 and the close of the year found it the second most important industry of the Commonwealth. Gold production increased steadily, output being approximately 51,000,000 pesos, as compared to 44,420,000 in 1936. Twenty mills are running, nineteen treating ore from lode mines and one recovering gold from tailings. The small placers also yielded gold. Monthly tonnage milled is approximately 245,000.

Prospects for 1938 are bright, although shadowed by fear of Government interference. Extension programs marked the work of leading companies in 1937. Several mills are being built.

As expected, the stock boom has collapsed. Prices of shares have declined steadily. Interest in mining shares is lacking, which has effected the industry's progress.

The base-metal industry has prospered. Figures for the first ten months show marked increase in minerals exported. Chromite shipments amounted to 44,106,202 kg., as compared with 8,035,884 kg. in the first ten months of 1936. Iron-ore exports were 533,030,764 kg., compared to 502,136 kg. for the corresponding period last year. Copper ore shipments jumped from 6,054 kg. to 13,177,652 kg. Manganese ore exported was 9,025,054 kg., compared to 254,000 kg. in the same period in 1936.

Mining profits have not increased in ratio to the larger production, because of increased costs. Freight rates have been doubled. Dynamite costs are 13 per cent above 1936 figures; steel balls and rails 50 per cent over last year's prices; steel plates 100 per cent more; diesel fuel 50 per cent more. Taxes in general are 50 per cent higher. These increases were anticipated to some extent by the larger operators, who laid in supplies, thus tying capital up in large amounts. Operating profits in 1938 will show the effect of higher costs.

The Sino-Japanese situation has had an injurious effect on Philippine mining, chiefly because it has caused a serious shortage of shipping space. Freight rates have increased at least 50 per cent. Japan is absorbing the entire iron ore output of the Islands, most of the manganese and copper, and some of the chromite. A major reason for its intense interest in the Philippines is found in the potentialities of the country's mineral resources.

The Commonwealth Government's attitude during its first two years has been anything but sympathetic to mining. In all fairness, however, it must be recorded that operators are worried chiefly about what may be done to injure the industry rather than by what has been done. The chief point of controversy is the interpretation of the Constitution, which took effect Nov. 15, 1935. This Constitution, authorized by the Tydings-McDuffie Law of March 24, 1934, provides that all property and rights acquired before its adoption would be respected. The Filipinos maintain that "rights" do not include the right to acquire mineral lands. Some 110,000 claims were located prior to Nov. 15, 1935, of which but 149 are patented. Many applications for patents were made, but the final granting has been delayed—deliberately, mining men believe.

Under the new Mining Law, signed by the President in November, 1936, all claims, except those patented, must be operated under a leasing system. The Philippine leasing system, unfortunately, provides that the locator of a claim shall not be entitled to extract minerals from it for commercial purposes until a lease is granted. The Government is further empowered to increase taxes at will, to cancel any or all leases for real or fancied violation of any provision or law, or to impose any regulation whatsoever. Mining men feel that the Government will do all it can to prevent the granting of leases to American or foreign locators. In substance, the Government denies the right of lawful owners of claims acquired under the former law to extract minerals until a lease is granted, even though they have been mining the deposits for commercial purposes for years. The claims already patented are owned by a few of the operating companies, and thus the future of some twenty producing companies, in which around 35,000,000 pesos have been invested, is endangered, as well as the prospects of many companies not yet producing. Within three days of the signing of the new Mining Law market prices of listed mining stocks in Manila declined 200,000,000 pesos. They have not recovered noticeably.

The relative position of the major mining organizations was unchanged. Benguet interests increased Benguet Consolidated's plant capacity to 1,000 tons, and shipped 20,000 tons of chromite ore from the Florannie and 15,000 tons from the Masinloc deposit. Marsman & Company boosted Itogon's capacity to 1,000 tons, increased output at Suyoc and United Paracale and installed a 50-ton smelter at Mambulao (since increased to 75 tons). Labor difficulties and shipping tie-ups delayed delivery of two 200,000-cu.yd. bucket dredges to Coco Grove. Chromite shipments from the Acoje property, in Zambales, started in October.

Soriano interests increased Masbate's plant capacity to nearly 55,000 tons a month. The I.X.L.-Argos was sold and is being operated by Royal Paracale Mines, Inc.

Consolidated Mines completed a 200-ton mill on its Tumbaga property, in Camarines Norte. Other new mills were started by Ambassador, Mindanao Mother Lode, Mineral Resources, Lepanto Consolidated, and Twin Rivers. Small-scale placer work was begun by North Mindanao.

Of the Ralston companies, Demonstration increased output and dividends. The 200-ton mill of Salacot was closed Nov. 1. Baguio Gold resumed dividends.

Mexico

Trend of labor costs upward continues as union presses gains. Government yields no ground in its program of social reform

IN MEXICO in 1937 the general economic situation lost some of its quondam rosiness. In the face of large revenues—the largest in the history of the country—the state of its finances worsened, due in part to the large expenditures necessary for meeting the requirements of the Government's program of social reform, in the pursuit of which the Administration continued unrelenting. Rumors gaining ground that there was to be an increase in the exchange rate, which has been 3.60 pesos to the dollar ever since the United States "went off gold," a rapid drop in the gold reserves ensued in the latter part of the year. This danger was averted, temporarily at least, by the sale of 35,000,000 oz. of silver to the United States Treasury. The exchange rate remained unchanged. As might have been expected, however, these conditions have bred an expectancy of remedial legislation, which, in turn, has lent the future new and additional uncertainty.

Mine operators could glean no encouragement from the events of the year, despite the high levels of metal production. Already beset with the need for devoting to labor problems their almost constant attention, they found no relief from this pressure. Strikes and demands for wage increases and new benefits were, as usual, galore, and the average wage paid for the year continued advancing. And giving point to the situation's possibilities was the spectacle of what was happening in the kindred petroleum industry. There, events starting with a twelve-day strike in May for increased wages and benefits, culminated later in the year in the adjudication of the dispute in favor of the employees in an award estimated by the companies at no less than 40,000,000 pesos annually. At the end of the year the oil interests were protesting the impossibility of compliance.

A new move on the part of organized labor marked the situation during the year. This in short was an effort on the part of the Sindicato to negotiate with each large operator a new and uniform contract covering all his operations in the country. Up to the year's end, nothing definite in this direction was accomplished.

Cause, also, for some apprehension in mining circles was the cancellation by the Government of certain concessions through the alleged retroactive application of principles contained in the Constitution of 1917 and providing for continuous work on new concessions.

Expropriation of the National Railways was effected by the Government, the decree being issued June 24, under the law passed by Congress at the previous session; foreign bondholders to be reimbursed after a valuation by the Treasury. Some 13,000 miles of road are involved in this step.

Due to the aforesaid increases in wages and other expenditures made in behalf of the workmen, mining costs rose still further. The more important mining enterprises, taken collectively, are estimated to have paid labor some 14 per cent more than in 1936, this including indemnities.

Added to these hardly encouraging factors was the decline in metal prices occurring in the latter part of the year, with consequent slackening or cessation of some mining operations. As a result, metal output, though high, was less than it would otherwise have been, this affecting not only the producers but also the workmen in certain camps where the wage scale is tied to the metal price. All things considered, the end of the year saw the mining companies somewhat worse off than at the beginning of the twelve months.

Production of refined metals indeed continued high and, despite the slip in prices, impressive totals were achieved, in cases surpassing those of 1936. Refined silver output is estimated at 88,000,000 oz., a 13½ per cent gain; and refined lead at 247,000 short tons, an increase of 2½ per cent. Blister copper turned out amounted to 53,000 tons, a rise of 32 per cent. Refined zinc, however, showed a drop of 4¼ per cent to 34,000 tons. In comparison with these, the mine production figures given out by the Department of National Economy indicate that the mine output for the year of lead as well as zinc fell below the corresponding totals for 1936 and that the mine output of silver was about the same as that of the year before, these figures, if they be taken as correct, revealing the occurrence of some curtailment in the fourth quarter.

Despite expectations to the contrary, no legislation bearing directly on mining was passed during the year. The new mining law proposed in 1936 was drafted but never sent to Congress. Although it had been anticipated that the President would issue it under the extraordinary powers previously granted him, he refrained from doing so, the powers referred to expiring on Aug. 31. Subsequently he gave out a statement that he would not seek to have them renewed.

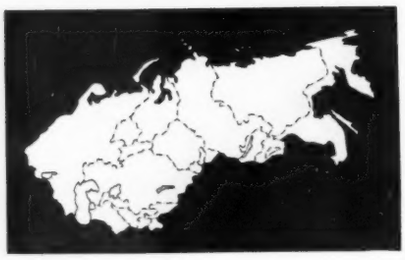
The status of mine taxation remained unchanged. The Income Tax Law, however, was so amended as to oblige all importers, whether merchants or not, to pay a tax of 3 per cent on the value of the goods imported. This had the effect of increasing import duties by 3 per cent of the value of the imports.

As told in these pages earlier in the year, possession of several mineral properties formerly held by foreign owners was taken by the President, with an old law as justification, according to report. Cases of expropriation have thus far been rare, however. The course more commonly pursued is to force mining operators to continue working under such conditions as to make their business unprofitable. The outcome usually is either the abandonment of the property or the decision on the part of the operators to turn their holdings over to their laborers, organized with Government aid into "cooperatives." Although this cooperative movement is being fostered by the Government, report has it that the laborers have no great enthusiasm for it. Only when an enterprise is collapsing, it is said, and there is no other way to continue working, because of the complete exhaustion of the capital, do the labor leaders insist on forming a cooperative in the hope of prolonging the life of the enterprise through loans and subsidies from the Federal Treasury.

Soviet Union

Mining industry progressed slowly through second Five-Year Plan shackled to bureaucracy, poor transport, and lack of equipment

H. C. Chellson
Assistant Editor



TEN YEARS of concentrated effort in planned economy still find the Soviet base-metal mining industry far behind production objectives demanded by Government leaders. Output has increased from year to year, but not at the rate so vigorously planned for defense and coordinated industrial growth. Exploration parties report finding new metal deposits each year, but Russia's size is so unwieldy that ambitious plans to exploit new and old mines are constantly beset by insufficient railways, poor highways, faulty truck manufacture, lack of practical mining and metallurgical engineers, and a woeful shortage of mining, milling, and smelting equipment. These general deficiencies, sunk in the country's top-heavy system of muzzled bureaucracy, have choked initiative and restrained intelligent Russian engineers fom making important technical decisions for fear of making honest mistakes. The recent "purge," climaxing the last year of the second five-year plan, has removed many mining engineers from responsible positions and has further crippled the industry. Production programs last year were, therefore, not fulfilled.

Russia's gold-mining industry, during the second five-year plan, seems to have gravitated more to capitalistic principles than, perhaps, any other phase of Russia's economic set-up. Reward in high pay based on personal initiative came to thousands of workers who formed artels and privately operated small placers and gold lode mines. Better food and other necessaries are found at gold mines and can be purchased only with gold or gold coupons. This feature has induced thousands of people to work in the gold fields and improve their welfare in Russia.

Revised figures on gold production based on Soviet data indicate that production in 1936 was about 6,300,000 oz. (*E.&M.J.*, Nov., 1937), compared with an earlier estimate of 7,300,000 oz. Some observers believe gold production increased in 1937 above the 1936 level, but since no specific Soviet data on 1937 gold output have been announced, present estimates from 6,000,000 to above 7,000,000 oz. prevail. Some authorities are inclined to accept the lower figure, as it is reasonable to assume disruption in operating schedules (especially in the last six months of 1937) prevailed in gold mining as well as in every other branch of industry, due to the severe "purge." It is, therefore, considered possible that gold output for the first time in the second-year plan failed to achieve the planned objective and perhaps fell below last year's output. Production of 11,740,891 oz. on the Rand in 1937, a new high, leaves the Soviet still far behind its boast to surpass that figure by 1939. It is believed more attention will be given to base-metal production during the third five-year plan and that gold production will remain steady between 6,000,000 and 7,000,000 oz. with substantial increases likely in 1941 and 1942. New gold mines are being equipped and plants in Eastern Siberia are now in the process of doubling capacity.

Copper output failed to meet the planned objective of 155,000 tons set for 1937, and imports estimated at about 70,000 short tons were made during 1937, which compare with 50,000 tons in 1936. Preliminary estimates on Russia's copper output for 1937 are placed at about 100,000 short tons, which include about 15 per cent recovered from scrap. Construction at the large copper-smelting plants in Kazackstan and the Ural continues behind schedule, and it is considered probable that copper output will not materially increase until these plants are ready, some time toward the middle of the third five-year plan. A railroad from Karaganda to Lake Balkash near the large Kounrod copper mine in Kazackstan is expected to be finished during 1938. The copper industry is viewed in Russia as a laggard, but the third five-year plan may perhaps materially change this attitude.

Lead production is estimated to be about on a par with the 1936 output, or 55,000 short tons, compared to the planned output of 126,500 tons. The lead smelter at Chimkent is reported to have improved some operating difficulties, and steadier shipments from the Atchesai lead mines made it possible to make up production lost in other directions during the year. Imports of lead for the first nine months of 1937 were 32,600 short tons, compared to 34,000 tons recorded for all of 1936.

Russia's zinc industry is estimated to have produced about 67,000 short tons of metal from four plants during 1937. The Cheliabinsk and Orjonikidize electrolytic zinc plants produced more than 50 per cent of the total. Lack of concentrates is thought to have held up production at the Konstantinovka and Belovsk zinc plants. Planned output including metal in ore was 110,000 short tons. Imports of zinc increased materially, about 31,600 short tons for nine months of 1937, compared to about 100 tons imported in all of 1936. More than half of the zinc produced is estimated as going into armaments. Very little galvanizing is done and about 25 per cent is estimated consumed in making paint. Two more zinc plants are projected. One at Kemerova has the foundations built and the other, having an annual capacity of 70,000 tons, will be started at Ustkaminogorsk.

Continued lack of sufficient metal supplies has prompted the Government seriously to consider the establishment of a trust devoted to collecting all kinds of scrap metal in the country. Increasing tension along the Eastern and Western borders of the U.S.S.R. and the influence of the severe campaign within the country to eliminate "wreckers" and spies have given most of the people of the Soviet a case of jitters, which observers believe will take some time to remove. The third five-year plan was, therefore, launched in a sea of uncertainty, and strong constructive action is believed necessary to minimize the influence of losses experienced in 1937.

Africa

New high records for production set by gold and copper. Important mineral discoveries scarce. Expansion continues on Rand

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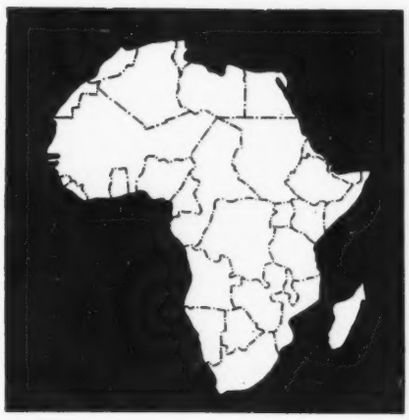


PROSPECTING and exploration for new mineral deposits were conducted throughout Africa the past year, but, because of the almost total absence of important discoveries, lost much in popular interest. Nevertheless, development of known properties, new equipment, plant expansion, and increases in production continued.

The Italians are reported to have discovered gold in the Abyssinian mountains and to be recovering some of it from a small mine and from river gravels. As guerrilla warfare is continuing in the country, the development of mineral resources seems likely to be slow. Prospecting for gold in the Sudan continues. Unfavorable operating results in Kenya Colony have dulled former enthusiasm. Serious work has been done by Kimingini Gold.

Germany's insistent demands for return of colonies has detracted from interest in prospecting, development, and equipment of mines in Tanganyika Territory. With the support of Tanganyika Concessions and Zambesia Exploring, however, Kentan's Geita Gold and other subsidiaries are erecting a 250-ton mill to serve their properties south of Lake Victoria. Developments have continued favorable with East African Goldfields.

In Southern Rhodesia extension of developments, expansion of plants, and increases of output were general, and the year's gold production will probably set a new mark. There are now 650-odd producers of gold. Chrome production was largely increased.

Up to June 30 the three operating mines in Northern Rhodesia, Rhokana, Roan Antelope, and Mufulira, produced 182,044 long tons (203,889 short tons) of copper—a new high record, and a far larger tonnage than has ever been produced in one year in the Belgian Congo. Resumption of diamond drilling to prove extensions of the ore deposits further has been considered. But the three companies have 307,994,904 short tons of ore proved in the properties already equipped and producing—this not including Nchanga's deposits or those in Mufulira's Chambishi and Baluba areas—which at last year's rate is a 46 years' supply. Economy therefore demands greater plant capacity rather than more ore.

Work of dewatering Nchanga Consolidated shafts and sinking a new hoisting shaft went on. This company, which will become a fourth important producer within four or five years, has a prodigious development and equipment undertaking ahead and funds in hand to complete it.

Elsewhere in Northern Rhodesia, Rhodesia Broken Hill's history is one of practically unavoidable misadventure. Accompanying its lead-zinc ores are important deposits of vanadium. In 1936 and 1937 demand for vanadium increased greatly, and in the latter year zinc production returned a fair profit. Drilling proved lead-zinc-vanadium ores at depth to justify draining for deep mining.

Gold developments in Northern Rhodesia have continued disappointing. The most important occurrences so far found are those of the Kansanshi mine of the Rhodesia-Katanga Company. Kansanshi is being equipped for treating the copper-gold ores by the segregation process perfected by Minerals Separation, Ltd.

Nothing of great interest was reported as to gold and tin mining in the Belgian Congo, but output of tin seems to have increased less rapidly than hoped. Union Minière made further discoveries of copper ore, and raised its output at one time to a rate of 180,000 metric tons of copper annually. Its production for the calendar year was probably a new high record. Under the curtailment program it will be smaller.

Activities destined to make the Witwatersrand a larger gold-producing area continued. Drilling by several companies proved the extension of the area of payable gold many miles to the west. On farm Gerhardminnebron, 40 miles southwest of Randfontein, what is claimed to be the deepest drill-hole in the world cut a pebble band at 10,035 ft. which contained 16.7 dwt. of gold over 12 in.

In the older portion, developments included the sinking of many new shafts, extension of deep levels, expansion of milling facilities, treatment of larger portions of the low-grade ore, and addition of new producers. The high record of production (11,558,532 oz. in 1932) was approached if not exceeded, and it seems certain a new record will be made this year. More men are employed than ever before.

Diamond production was increased to supply the growing demand. This slackened toward the end of the year, however. Plans are perfected for reopening the Jagersfontein mine. Some excitement occurred over the discovery of diamondiferous ground in Bushmanland, options being secured on many farms.

Moves were made early in the year toward opening the two copper mines, both relatively small, in South West Africa, one of which is owned largely by Newmont Mines and the other chiefly by German interests.

Gold Coast expectations, though considered too optimistic by many, progressed toward realization. Developments were favorable, particularly in the banket reef, where good values were opened. Better still, initial dividends were paid by several companies. Ashanti continued to hold its place. Diamond mining by Consolidated African Selection Trust on the Gold Coast continued productive. Its subsidiary operating in Sierra Leone also added to plant.

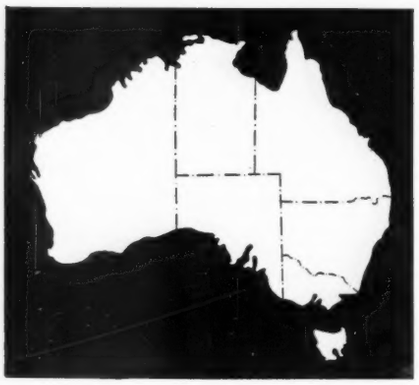
Mining is making Africa the world's most prosperous area. There is little unemployment, and in some districts a shortage of native labor exists.

Australia

Gold output of Commonwealth again increases, three quarters coming from Western Australia. Base metal output also up

Peter G. Tait

Melbourne, Australia



ONCE AGAIN the year's gold production of Australia shows substantial increase over that of 1936, which was 1,174,925 fine ounces. For the first nine months it was 993,146 oz., indicating a total for 1937 of over 1,250,000 oz. Thus in the past seven years annual production has nearly trebled, while the value of Australian currency has been around £8 16s. per ounce.

The zenith of the gold boom has been passed. Hundreds of old mines have been reopened (and many of them closed again), but the number of entirely new discoveries is limited. Improved treatment, motor-vehicle transportation, the compression ignition heavy-oil engine, and the wood-fuel gas producer plant have all contributed.

Golden Plateau, in the Cracow field, Queensland, is an example of a new mine living up to optimistic anticipations. On a paid-up capital of £113,750 it has distributed £609,000 in dividends to November, 1937. It can mill 5,000 tons monthly. Total costs are just over 25s. per ton.

Among the failures of resuscitated mines is the well-financed scheme for reopening the Victorian deep alluvial mines in the Talbot district. All efforts to locate leads like those formerly worked have failed.

Bendigo has been disappointing. Judged by results, this field can be worked only by small companies with low overhead.

Of the other fields in Victoria, Chewton has attracted most attention by reason of the success of the Wattle Gully company, which will produce over 10,000 oz. for the year, and is a regular dividend payer. Numerous other companies have been formed, most of them being still under development.

Dredging is not carried on extensively in Australia, but several plants are at work in Victoria. Cock's Eldorado paid its first dividend in 1937. Adelong Company is making satisfactory profits. The Bright Valley dredge, started several months ago, has reported profitable returns. Redbank Dredging is placing a small bucket dredge in the Avoca district. Victoria Gold Dredging, at Newstead, is installing a bucket dredge equipped for resoiling.

In New South Wales, Wellington Alluvials, Ltd., subsidiary of Broken Hill Proprietary, has installed a dredge to operate on the Macquarie River.

Western Australia produces about 75 per cent of the Commonwealth's gold output, and at the present price the reserves available assure continued prosperity. Average grade of ore hoisted is not more than 7 dwt., whereas in 1903 it was over 21 dwt. The Kalgoorlie mines, having completed reorganizations and plant additions, are running on an even keel. Wiluna has had a setback owing to a fall in tonnage available and values on the bottom level. Lancefield is less optimistic owing to an apparent contraction of its orebody. The outstanding mine development is the Big Bell, at Cue, developed by American Smelting & Refining Company. Ore available is put at 3,000,000 tons assaying 3.7 dwt. Milling began in September.

Mount Morgan, Queensland, is treating weekly over 6,000 tons of sulphide ore, running 3.43 dwt. gold and 0.66 per cent copper. The 800-ton (daily) oxide plant was started a year ago. Though ore grade was lower than anticipated (2.7 dwt.), and recoveries were also low in the early stages, better results are reported. Present intention is to mine by open cut and treat 8,000 tons a week, which would give twenty years' life.

Mines of the Cobar district, New South Wales, are controlled by New Occidental Company and are nearing full-scale production. With treatment plants completed, 1938 should see New Occidental one of the largest gold producers outside Western Australia.

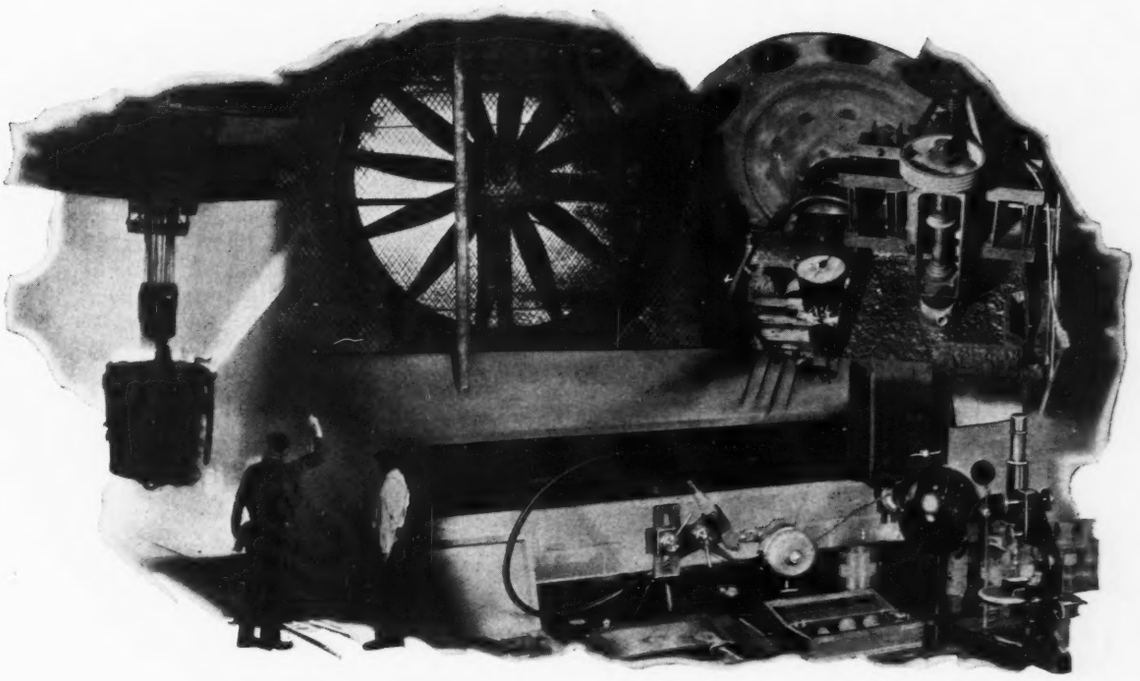
In New Guinea, Bulolo is starting additional dredges. New Guinea Gold Mines is operating two small mills. Alluvial gold is also being recovered. In adjoining Papuan territory the only important producer is Cuthbert's Misima, which is paying dividends.

Base Metals—Complete figures from the Broken Hill field will probably show that the 1936 total of 1,356,600 tons has been exceeded. The five main producers, in order, are: North Broken Hill, Broken Hill South, Zinc Corporation, Sulphide Corporation, and Broken Hill Proprietary. New Broken Hill Consolidated was formed to acquire leases adjoining the Zinc Corporation. Development is under way. Despite the 35-hour week and high wages, the companies enjoyed a successful year. Notwithstanding that over 40,000,000 tons has been hoisted, Broken Hill has years of large production ahead.

Arrangements for reopening Lake George Mines, at Captain's Flat, N.S.W., have been completed. The Government will build a railway costing £192,000. The company will spend £600,000 on mines and plants.

Mount Isa, in sub-tropical Queensland and a long rail journey from a shipping port, is at disadvantage compared with other fields. For the year a net profit of only £70,309 was earned before depreciation.

Electrolytic Zinc, at Risdon, Tas., treats zinc concentrates from Broken Hill mines, but in the last financial year its own mines were in full operation. Production was 49,540 tons of zinc concentrate and 10,246 tons of lead concentrate. Proved reserves total 1,500,000 tons. With British Aluminium the company produces aluminum for local needs, importing the necessary alumina. An interest has also been taken in Imperial Magnesium Corporation, Ltd., but there is no talk of manufacturing in Australia, though another company has been established in Tasmania for the purpose.



Technology Moves Ahead

HOW SLOWLY technology seems to move—at times and in places—and yet it does move! Witness the following pages, dealing with only the recent developments in this far flung mining world of ours. Just a glimpse of what is being done in mills and smelters, and in the mines, not only of this country but abroad—for technology has essentially no nationality. One knows, of course, without its being said, that not everything new is here recorded. For secrecy, that retarder of progress, still afflicts some enterprises, even in the United States, where the free exchange of information has been such a tremendous spur to industry and is one of the explanations of its tremendous development. And how often secrecy proves to have been futile, concealing something that was hardly worth revealing! This in passing. Mill men and metallurgists are on their toes, as the record indicates. Especially worthy of note is the work being done to improve ore beneficiation in the Iron Country. Likewise in practice at the lead and copper smelters and in the field of electrometallurgy, accomplishments that deserve attention have been recorded by the technologist-authors, who, over a period of several months, have taken pains to gather the interesting data they present.

Ore Dressing Benefits by Research

Details improved and some older practices revived. Flotation finds increasing scope of application

A. W. Fahrenwald

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WHEN ONE STOPS to contemplate the present state of the art of ore dressing, and to note the progress made, it is obvious that improved demand for metals and mineral products has stimulated much activity. Operators, manufacturers, researchers, and inventors have made contributions. The progress generally is in the nature of refinement in the art, and the technologic progress is rather the result of cumulative knowledge coming from a wide source, and from many people.

Materials Handling—One notes a constant improvement in the mechanics of ore handling. There is a wide and growing application of anti-friction bearings to all kinds of conveying equipment. The gear-motor power transmission unit and the V-belt pulley drive have led to much improved performance and to reduced operating attendance. In sand pumps, rubber-wearing parts, anti-friction bearings, and reduction in weight by using light metal castings are items to be noted. In this category come ore-feeders, and the most recent contribution here is the dual purpose Merrick Feedoweight and the Jeffrey Waytrol.

Intermediate and Fine-Crushing—In the smaller plant, the jaw crusher of the type in which the main eccentric shaft both supports and actuates the swing jaw (wheeling) has been popular because of its simplicity and compactness. In it the anti-friction bearing has demonstrated its mechanical soundness and ability to reduce operating costs. Many operators, however, at the cost of decreased capacity and high steel consumption, try to use it at too fine a set, a job which its principle of design does not permit.

The Symons short-head crusher has progressed. It is a competitor of the rolls crusher. The idea of the short-head, among other objectives, is to hold the crushing reaction force transmitted to the bearings to a permissible unit-bearing pressure. Other finishing crushers (reducing to minus $\frac{1}{2}$ in.), in which the mantle is proportionately larger at the discharge circle than at the mouth—a requisite principle in reduction crushers—have made fine progress. In the operation of this type of crusher, with spring head or rigid head, it is now generally appreciated that magnetic means to catch steel should be employed.

The gravity stamp remains *in statu quo*. In quality of work, it holds its own, and as a liberator and polisher of free gold it is favorably remembered. Its impotency as a large-tonnage crusher is its inherent shortcoming, unless used strictly as a crusher to prepare grinding mill feed, as at the Homestake. Stamping in closed circuit with a classifier, thus avoiding screens, has yet to receive proper consideration.

Fine Grinding—Ball mills more than hold their own and no doubt will continue to do so for some time. Their advantage lies in compactness, potency to deliver tonnage, and, under proper conditions of design and operation, to make a fine finished product. Studies of fundamentals of ball-mill grinding, primarily by Bureau of Mines engineers, have helped tremendously in understanding and improving their performance. They clearly indicate that in design, among other things, much consideration should be given to mill diameter and amount of pulp to be held. The relationship of diameter to capacity, expressed by the formula $C=D^{2.5}$, has not had enough attention. Neither has the importance of pulp capacity as determined by size of discharge trunnion or by grate and lifters, been properly exploited. Particularly is this true when the factor of mill speed is considered. High-speed mills (operated at critical speeds up to 150 per cent), attractive as laboratory work indicated this idea to be a few years ago, have not succeeded practically. The bugbear was high liner consumption, which was out of proportion to the increased grinding capacity. In operation and control of mills, De Vaney and Coghill (*E.&M.J.*, July, 1937, pp. 337–340) point out that ball wear for loads of equal weights is independent of ball size, and that ball wear for equal power input is independent of mill speed. For steel balls, the average wear per horsepower-hour is about 0.15 lb.; when the wear exceeds this amount, the ore probably is abrasive.

Of interest in ball-mill design is the application of "non-metallic" bearings (*E.&M.J.*, October, 1937). The lubricant is water. Use in this one instance resulted in substantial saving in power.

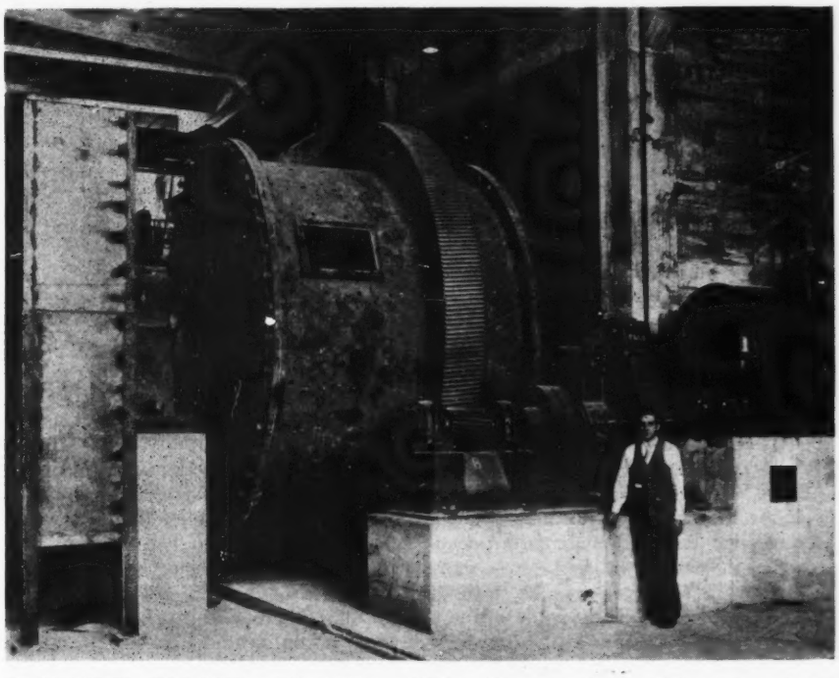
Rock Mill Grinding—The "rock mill,"—that is, the type of grinding machine in which rock or mine-run-of-ore is the grinding media—has failed to progress. A number of reasons may be suggested. Due to the low specific gravity of the (rock) grinding media, large bulky machines are required per ton of finished product. There have been and still remain serious mechanical problems. Commercial advantages of this type would lie in a saving in steel consumption and of horsepower. Favorable horsepower-ton data came from some of the Hadsel mill installations. The rock mill has possibilities, particularly when used with the secondary crusher. It is doubtful if this process can successfully lend itself to the "one easy step" method.

Fine Grinding by Squeezing—Nearly any fineness of comminution, if at the expense of capacity, can be effected in such machines as the stamp or the rolls crusher, the latter operated choke-fed and in closed circuit with classifier or screen. A suitably designed gyratory crusher likewise may be employed in this manner, and products as fine as minus-65 and minus-100 mesh can be made. Crusher "sets" of about $\frac{1}{4}$ in., choke feed, and large circulating loads, generally are the conditions needed. Power and steel consumption are less than for ball mills. Capacity is proportional to power input. Some work has been done in this field.

Explosive Shattering—Little progress for this unique method of rock disintegration is reported. Crushing selectivity by which mineral disintegration takes place to a maximum degree on planes of weakness and at surfaces of contact between the unlike minerals, has a strong appeal in ore

comminution, particularly in those cases where production of colloidal fines results in metallurgical losses. Perhaps a mechanical genius will give this process the finishing touches necessary to make it practical.

Screening—The high-frequency vibrator screen in recent years has appeared in various forms. Vibrations are imparted in numerous ways mechanically and electromagnetically. The newest of this type has the screen surface horizontal rather than inclined. The reaction of the vibrations is such as to carry the bed of material on the screen forward at a rate to give efficient screening. Modern screening units are outstanding for their mechanical excellence. Little or no research in this field and no new principles of screening have been forthcoming.



IN THE NEW STAR MILL of the Sullivan Mining Company, Burke, Idaho. One of two 10½x8-ft. barrel ball mills with cone ends. It is driven through a spiral gear and herring-bone gear reducer by a 400-hp. synchronous motor

Classification — Mechanical classifiers have been refined and strengthened mechanically. The advantage in fine grinding of high circulating loads (up to 500 per cent) has demanded higher sand-raking capacity and in turn increased mechanical ruggedness. Of interest is the new Dorr "Multizone" classifier (*E.&M.J.*, May, 1937). The distinctive feature claimed is the utilization of a combination of turbulence, high pulp velocity, and quiescent overflow to obtain a cleaner sand product and a more readily controlled overflow. Several are in use.

Hydraulic Classifiers—The year has brought little new in multiple-spigot hydraulic classifiers. The wide application of flotation and its attractiveness for study have not been conducive to research in this field. Where tables find use, and particularly when maximum efficiency of them is required, the constriction-plate, density-controlled type of hydraulic classifier definitely has a field. In concentrating tungsten ore, a field which flotation has not yet invaded to any extent, hydraulic classifiers are in their element. Also in cases where flotation could be applied, but where the oily films in the concentrate are objectionable, hydraulic classification as the right-arm of tabling plays a useful rôle.

Jigs—Jigs, mostly old in principle but largely new in design and better of control, are now marketed by several engineering firms. Mineral jigs are again, to a limited extent, serving their original purpose of recovering coarse mineral (or rejecting coarse tailing). Jigs are economical of operation and the products they make are saved from further comminution with consequent additional grinding costs and metallurgical losses. Jigs are more than ever before finding a field in recovering gold from ores and in dredging. At Montezuma-Apex (*E.&M.J.*, Vol. 138, 1937, p 352), a 12x12-in. water pulsator jig removes free gold from pyrite flotation concentrate, and will also recover free gold from black sand.

Tables—It is generally acknowledged that a table works most efficiently on feed prepared by hydraulic classifiers. Now, more research data (N. P. Titkov. Gorno-Obogatitel. Zhur, No. 8, 29-33, 1936) bearing on this subject are available. The table is not only definitely still in the picture, but finds a new, or newly revived, application under improved conditions in treating oil-agglomerated pulps. This process utilizes the principle of selective water repellence. When the agglomerated pulp is fed to a table, the oiled minerals pass over the tailings side of the table. The process has been applied to separation of phosphate rock from quartz sand (Bureau of Mines, R.I. 3105, 1931), calcite from quartz (R.I. 3247, 1935), and sylvite from halite (R.I. 3271, 1935).

Heavy Sand-Water Pumps—The principle here is that operative in the first pocket of the good hindered settling classifier; for example, in the case of galena ores. The heavy galena-water teeter column, with a density over three, collects only coarse galena. The process has wide application in coal-washing. A contribution in this field has come from the Michigan College of Mining and Technology (Frank Tolonen, *Min. and Met.*, September, 1937), where application to beneficiation of Michigan iron-bearing formations has been experimentally studied.

Air Flotation—A table concentrator, employing air as the stratifying medium instead of water, is that sponsored by Sutton, Steele & Steele, Inc., Dallas, Tex. It has wide application in concentrating ores, including various non-metallics. Stratification is caused by combination of the mechanical action of the deck and a rising current of air forced through a porous table deck cover. The principle is attractive.

Flotation—Few changes have been made recently in flotation apparatus, flowsheets, and pulp circuits. Application of the process, however, has steadily widened. Hundreds of capable researchers have been active. Research has been confined largely to reagents and reagent combinations for selective oiling and selective wetting of minerals.

Since the first insight into the actual mechanism of flotation, dating back to the results of the early researches of Dr. Langmuir in 1918, and the first application of xanthates shortly thereafter, reagents and reagent combinations have been sought by which commercially valuable minerals could be separated (concentrated) by flotation. Many overlapping problems have been met.

Frothers—Generally the properties of a reagent needed to make a froth, when added to and agitated with water, were understood. Many of these were possessed by pine oil and cresylic acid, the present commercial frother. Research, however, recently has brought forth new pure frothers con-

(*Continued on page* 80)

Lake Iron Ore Studies Pressed

Open-pit mine operators active in studying beneficiation problems. Satisfactory work done during year

UNUSUALLY great interest in iron-ore concentration methods marked the 1937 ore shipping season, and much experimental work, both in laboratories and plants, has been done. But the most favorable factor relating to beneficiation was the amount of work done on mining methods.

Almost invariably, ore beneficiation is considered solely as a metallurgical problem, and mining is regarded as a necessary but subordinate detail. With many ores, and especially low-priced ores like iron ore that may be concentrated by a simple and inexpensive process, the mining cost is the largest item of the cost of producing the shipping product. The costs of mining the crude ore are always magnified when figured in terms of concentrate, and similarly reductions on mining costs are magnified in terms of concentrate costs. While only wash ores were being concentrated and the product averaged 65 per cent of the weight of the crude ore, the effect of mining cost was not so noticeable, but with the use of jig ores where two tons of crude ore are required to make a ton of concentrate, it is plain that mining cost per ton of concentrate will be twice that per ton of crude ore and a saving of 1c. per ton in the crude ore cost will mean a saving of 2c. per ton in cost of concentrate.

Numerous tests made to perfect standard methods of open-pit mining and many attempts to lower transportation costs by use of trucks, motorized dump cars, and conveyors, are sure to be reflected in lower mining cost, which in turn makes more lower-grade ore available for economical treatment. At nearly every open-pit mine in the Lake Superior district serious consideration has been given these newer methods, and it can be assumed safely that this increased interest in mining is the most important development of the past season as pertaining to iron-ore beneficiation. In working out the treatment of lower grades of iron ore, with their lower recoveries, much more time may have to be spent in devising satisfactory mining methods than in determining best metallurgical practice. The willingness of an industry to experiment with new machines is always a healthy indication. The past season more machines new to iron-ore concentration were tried out than in the last ten years. They included classifiers, jigs, screens, magnetic separators, and differential density cones. More ore was shipped to the University of Minnesota Experiment Station than in any other single year.

Use of conveyor belts for transporting ore in the mines has prompted the idea of having the concentration plants alongside the open pits instead of near suitable ground for tailing disposal, as in the past. The mine conveyors thus deliver ore directly to the plants, cutting down transportation costs and centralizing mining and concentrating. If a tailing basin adjacent to the pit cannot be had, it is more economical to transport the tailings only than to haul all the crude ore to a plant near the basin. All plants built this season were placed alongside the pits.

Crushing is the simplest operation considered a beneficiation process. Although there is much discussion among blast-furnace men about need of finer crushed ore for furnace use, this has not been reflected yet at the mines, and no changes in crushing methods have been made this season.

Crushing preparatory to ore treatment has seen only one innovation and that is where ore is being delivered by conveyor belt to the plant from the open pits. In these mines, a primary jaw crusher is installed in the pit where it crushes the ore lumps to a size that can be fed upon a belt.

In ore washing Dorr F X bowl classifiers are being used in place of the D classifiers. At two plants, Aikens classifiers have been used for the first time in this region. The argument as to the respective merits of log washers and of Dorr washers as coarse classifiers still continues. In the new plants that needed such equipment, choice has been determined by availability of second-hand equipment.

More attention has been paid to concentrate stock-piling equipment for taking care of railroad car shortages. One large conveyor belt stocker was installed and more are planned for next year.

Horizontal shaker screens are making inroads in what was once considered strictly a field for vibrator screens. Saving in head room and the small amount of screen wear are responsible.

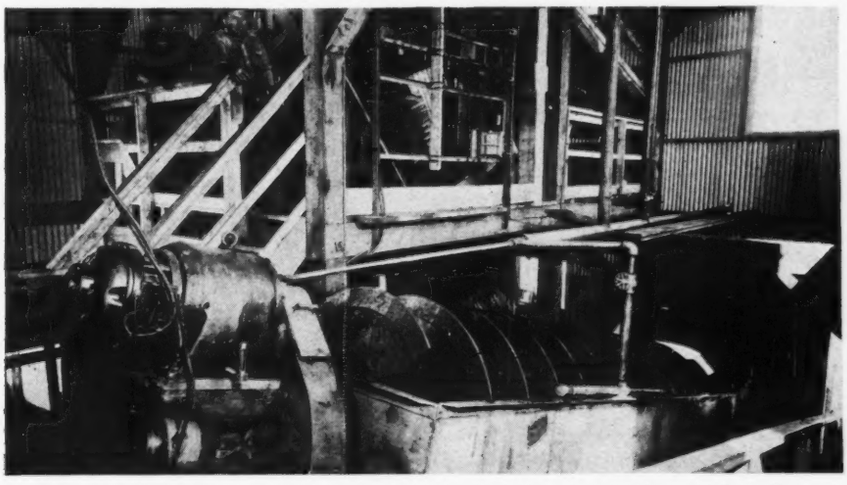
The large demand for ore the past season has been responsible for opening a number of mines thought exhausted. From these were scrammed small tonnages of direct-shipping ore, or of wash ore which was concentrated in a simple washinging plant. In most instances, only a small amount of ore could be thus obtained, but after it was mined out a substantial amount of jig ore was frequently left. For this reason, many smaller operators have been investigating jigging methods and equipment. Some of the larger companies also are paying attention to jigging, as it is thought more economical to treat the jig ores which surround the direct shipping and wash ores of nearly every pit, and thus delay the time when new properties have to be developed.

Two types of jigs have been in use for some time—Hancock and the McLanahan Stone. Four others were tried out this past season. The Ore Reclamation Company, of Picher, Okla., installed its jig in two plants. This is a Cooley-type jig, equipped with bucket elevators to elevate and dewater coarse products drawn from above the jig screens by star gates. Bendelari jigs were installed at one plant. These obtain their pulsations from a diaphragm actuated by an eccentric. The Wood jig which is being developed by Nordberg was used at one plant. It is a diaphragm jig equipped with two screens and a ragging of steel balls between them. It was devised last spring. Another plant tested the pneumatic tube jig designed by H. H. Wade, of the Minnesota Mines Experiment Station. This is a stationary screen jig which obtains its pulsations from the alternate inflation and deflation of an 8-in. diameter pneumatic tube placed a little below the jig screens. The object of this type of pulsation is to eliminate suction so as to increase the jig's capacity for unsized ore.

Compared with other ores the iron ores classed as jig ores are not particularly hard to jig, but one factor that makes jigging difficult is the changeable nature of the ore as it occurs in the open pits. Where jig ore is obtained from underground mines, the jig feed is usually uniform, due to its coming from a large number of working places. Where the

ore comes from only one unit, such as power shovel in an open-pit mine, it is likely to change rapidly in grade. To take care of this condition, more rapid and frequent adjustments of the jigs are necessary than with most ores.

To replace jigs and to eliminate this difficulty much work has been done with the so-called differential density cones, which operate on the same principle as the Chance sand cones for cleaning coal, except that finely ground galena is used in place of sand. One plant has employed this process with success, and more experimental work will be done this winter to overcome some of the difficulties.



A SPIRAL CLASSIFIER at an iron-ore beneficiating plant in the Lake Superior Iron Country. At two plants this type of classifier is being used for the first time

Roasting and magnetic concentration has been continued at one plant all season. Although this work is now on a commercially successful basis, more experimental work has to be done in reducing fuel costs. For concentrating the roasted ore a Crockett-type Dings separator has been tried out for comparison with drum-type separators.

Only two sintering plants have been operated, but more are being planned. Some of the steel companies may soon require all fine ore to be sintered before shipment, or at least all that cannot be absorbed with flue dust and sintered at the furnaces.

Much work has been done on flotation of iron ores at the Minnesota School of Mines, but none at any of the plants. Tests at the University have been so successful that further work is warranted.

Trend in ore concentration seems to be definitely towards a sharp increase in jigging. Depletion of wash ores is bringing this about sooner than would be expected, because it is realized that the time to start jigging at a mine is before all the wash ore is gone. The value of some wash ore as a "sweetener" when low-grade jig ore is met is appreciated.

Jigging is comparatively inexpensive, but at best is only a roughing process. It produces a tailing that still contains much iron. Just how to recover this most economically is one of the problems requiring study. Roasting and magnetic concentration undoubtedly could save most of it but are expensive. Flotation may prove more economical, but much work may be needed for developing a suitable technique. Still another possibility is the improving of classifiers to separate fine ore from fine gangue.

Progress of laboratory research during 1937 was much the same as in the last few years. Little has been done in improving washing methods. Most of the work has been on methods for treating ores that contain rock and which would have to be treated by jigging, differential density separation, or some similar method. Much laboratory work is being done to find jigging methods for recovering more fine ore—that is, 100-mesh material or finer. This work has been stimulated by introduction of the differential density process which cannot treat ores finer than quarter-inch size. Such material has to be tabled or jigged, and most of the study has had to do with jigging methods for concentrating such material.

Heretofore, only academic interest was taken in jigging with heavy suspensions as worked out by F. J. Tolonen, of the Michigan College of Mining and Technology, but recently laboratory jigging has been inclined towards that method. It is accepted that efficient jigging of iron ores is almost impossible without circulation of a middling. Usually the latter is ground in a rod or ball mill which produces fines to approximate the high density conditions obtained by Mr. Tolonen. Just how far this grinding and recirculation can be carried on, economically, is one of the problems that is being investigated. Tests so far indicate that the more ground middling circulated, the higher the recoveries and the easier it is to obtain and maintain the desired grade of concentrate.

Laboratory work on differential density methods consists mainly in trying new mediums for building up high densities. Galena makes a suitable medium for only a short time, as it abrades too easily, forming a slime that makes it useless. Other high-gravity materials are being investigated.

Little work has been done on tabling Lake Superior ores this past season. One objection is the difficulty of distributing the feed to tables and collecting the products. Much interesting work has been done in the past on tabling coarse sizes of iron ore, but the distribution and collection problem has hindered the investigation.

Laboratory work on flotation has been confined mainly to making tests on as many ores as possible to note the effect of the minerals contained. Lake Superior iron ore is made up of a large number of iron oxide minerals varying from magnetites to hematites and then through hydrated oxides to limonite. The proportions of these vary widely in the same orebody. It has been questioned whether one set of reagents could be found that would float all of the iron ore minerals found in one day's production from an iron mine. It is possible that the field for flotation will be to follow jigging or magnetic concentration to treat the tailings of these processes. Often the range of minerals in such tailings is limited and reagents may be found that will be suitable for such range.

Much laboratory work was done during 1937 on ore roasting for magnetic concentration. Each cost item is being considered, and the laboratory work has consisted in trying out methods that might reduce individual cost items. Fuel used for heating and for reducing has been given the most consideration as it makes up a large part of the roasting cost.

Little work has been done in the laboratory on sintering except for ordinary sintering tests. Ore drying has received attention, and with increases in freight rates may warrant more. Much heat is lost in most drying processes. Its conservation is a difficult problem.

In summing up the various investigations made during the year in plant and laboratory, one may say that the work done has been satisfactory. It is hoped that this interest in beneficiation will continue.

Copper Metallurgy Reveals Improvements

Cerro de Pasco separates lead and copper by new scheme. Longer campaigns at Clarkdale. Noranda increases tonnage

W. B. Boggs

Smelter Superintendent
Noranda Mines, Ltd., Noranda, Que.

DETAILS OF PRACTICE employed during 1937 at metallurgical plants in the copper industry throughout the world are given in the following, without particular respect to order.

At Imatra, Finland, the Outokumpu smelter entered its second year of successful operation. It treats a chalcopyrite concentrate. Two points are of particular interest: First, the heat required for operating the reverberatory is generated by electricity within the furnace by three electrodes, 1.4 meters in diameter, immersed in the bath. The operation is continuous, segments being added to the top of the electrodes, which are gradually lowered as their tips are burned away. The furnace is circular and the side walls have copper water jackets. Tapping and skimming proceed at intervals, progressively around its circumference. The total charge smelted averages 240 to 260 tons of new metal-bearing material plus converter reverts per day; this does not include the liquid converter slag. Transformer capacity is 9,000 kva., of which approximately 7,000 is used. Current at the electrodes is 100 volts and 50,000 amp. Current consumption is 590 kw.-hr. per ton of solid charge, equivalent to 890 kw.-hr. hours per ton of dry concentrates. Second, the Imatra smelter, adjacent as it is to a forested area, is required by law to remove the sulphur dioxide from its gases before discharging them into the atmosphere. This is done by cooling and scrubbing them in absorption towers with countercurrent flow of an aqueous solution of basic aluminum sulphate from which the SO_2 is subsequently distilled and liquefied. The sulphur dioxide so recovered is sold.

At Boliden, in Sweden, out of 400,000 tons hoisted in 1937, about 235,000 tons was concentrated, yielding 85,000 tons of pyrite concentrates and 65,000 tons of smelting concentrates. The remainder, 165,000 tons, went direct to the smelter. It is now crushed finer than before—to pass a screen with 7x12-mm. slots—which has improved the reverberatory work. Flotation concentrates are now dried before being bedded. Roasting capacity has become ample, due to the decrease of tonnage to be thus treated from 1,000 to 700 daily. Conditions in the converting department have also been improved. A plant has been added for wet-refining of the crude arsenic-bearing material from the roaster Cottrells. Further to decrease the sulphur in the stack gases, a process has been developed for recovering elemental sulphur by the catalytic reduction of the SO_2 by a reducing gas.

Harold Kingsmill, of Cerro de Pasco Copper Corporation, states that the corporation's director of research, T. E. Harper, Jr., has developed a method of decopperizing lead-copper flotation concentrates. Undertaken principally to improve lead metallurgy, this results in an appreciable decrease of lead in the copper-converter charge, and so simplifies copper smelting. The decopperizing is a selective flotation operation in which sodium dichromate is used to inhibit the flotation of lead sulphide (galena). Copper occurs as chalcopyrite, tetrahedrite, tennantite, and bournonite. Presence of the lead-copper mineral bournonite precludes a high separation efficiency. The separation treatment has been in use only two months, and results are steadily improving. Current results are given in the table.

Of interest is the rapidity with which minerals in the lead-copper concentrate oxidize. Separation tests made several years ago on stockpile concentrates were unsatisfactory. Recent work shows that the concentrate must be decopperized within 60 hours. A three-day lag caused an appreciable decrease in separation efficiency and after five days the degree of selectivity is practically nil.

At the Braden plant, in Chile, part of the flotation concentrates was reground and re-treated, increasing the copper content 20 per cent. Fuel consumption is only 2,716,000 B.t.u. per ton of solid charge. Maximum solid charges for continuous running are 1,300 tons per 24 hours, and for short periods 1,500 tons, and have reached as high as 1,683 tons.

In the casting department at Braden, a method has been developed for preventing all "sweat" on cakes cast from refined copper.

At Hudson Bay smelter, Flin Flon, Manitoba, it became necessary to handle an increased amount of custom ores in the reverberatory. "To do this," writes John H. Ambrose, smelter superintendent, "it would be necessary to burn more coal either by increasing the amount of coal to the present burners or by adding more burners and increasing the length of smelting zone. The latter was decided on, as it was expected not only to give additional tonnage but to assist in smelting 'floaters' which, owing to the character of feed, had often given trouble. Therefore, purely as an experiment we installed a burner through each side wall, about 30 ft. from the bridge wall, and at 60 deg. with the long axis. Although we were short of feed several times during the experiment, the results showed conclusively that the side burners were a benefit. We could not tell how much they would increase the capacity owing to lack of feed and to insufficient combustion area in the furnace and lack of outlet area in the flues. To correct the latter causes, the entire main furnace arch was raised 10 in.; the furnace width in the smelting zone was increased by reducing the thickness of the side walls from 24 in. to 13½ in.; and the area of the uptake and outlet flue was increased.

"A new Roots blower was installed to supply 250 lb. of air per minute at 7 lb. to the reverberatory burners to replace the air formerly taken from the converter blowers. This resulted in steadier firing conditions and can be credited with part of the increase from 930 to 1,030 tons of solid charge per furnace day. In September and

Data on Decopperizing Lead-Copper Flotation Concentrates, Cerro de Pasco Copper Corporation

	% Weight	Oz. Ag	Assays %Cu	Assays %Pb	Distribution %Au	Distribution %Cu	Distribution %Pb
Lead-copper concentrate...	100.0	155.9	13.8	38.2	100.0	100.0	100.0
Copper concentrate	48.4	264.3	25.8	13.2	82.1	90.8	16.8
Lead concentrates	51.6	54.1	2.4	61.5	17.9	9.2	83.2

October the average tonnage was 1,114 tons per furnace day and for the first ten days of November, when there was ample feed, it averaged over 1,200 tons. Capacity of the converters was increased first by installing a new 20,000-c.f.m. centrifugal blower, which allowed 20,000 c.f.m. of air for each of two converters; by increasing the size of the converter collars from 35 to about 60 sq.ft.; and by smelting in the converters 60 tons per day of custom material-added by Garr-guns."

At the Douglas smelter of Phelps Dodge Corporation, a new reverberatory with a large waste-heat boiler directly over the uptake has been completed. This is similar to No. 7 furnace built several years ago. This gives remarkably high recovery of waste heat for steaming. Boilers on No. 7 and No. 8 furnaces will ultimately operate at 400-lb. pressure.

At Clarkdale two 13x30-ft. Peirce-Smith converters have been installed, lined with periclase brick with insulation of Sil-o-cel for one shell and perhaps thermoflake insulation for the other. C. R. Kuzell reports on the Clarkdale method of renewing the interior refractory surface of reverberatories. This is done by spraying a water suspension of refractory material on the surface while the furnace is under full fire. Furnace campaigns are now terminated by external reasons, and long campaigns with high tonnages smelted result.

Mr. Kuzell's method of extending the length of furnace campaign is of such importance that a few details are given: A finely crushed quartz-sandstone is finely pulverized in Raymond coal pulverizers to an approximate fineness of 78 per cent through a 200-mesh screen. Clay is likewise pulverized and then mixed with water and subjected for several hours to treatment with live steam to accomplish thorough disintegration and suspension and yield a fluid clay slurry. The finely ground quartz and clay are mixed in suitable proportions in a concrete mixer and the mix is applied through a spray gun, using a 1½-in. iron discharge pipe, working under 50 to 60-lb. air pressure for arches. Lower pressures are used for side walls and flues. Successive applications are made until the desired thickness has been added. An experienced operator can build a patch up to a thickness of 6 in. Successful patching depends on applying the refractory in successive thin coats or layers and allowing sufficient time between applications to permit the heat to set the refractory.

Insulated roofs on the reverberatories at Inspiration are still showing a saving in fuel and an improvement in brick life. They have perfected "wet charging" of reverberatories. The Hayden smelter is again operat-

(*Continued on page 73*)

Some Advance At the Lead Smelters

Sintering machines larger. Blast furnace capacity increased. Drossing practice improved. Sulphur fixation progresses

G. L. Oldright

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ADVANCE in the metallurgy of lead in 1937 included improvements in sintering practice and in sintering machines; further increase in the capacity of blast furnaces; betterment of rough drossing practice and in the quality of the bullion, the load on final refining units having been decreased thereby; and the continuation on a large scale of the work on fixing sulphur from smelter gases.

Feed to Smelters—Many smelters continue to receive the bulk of their lead as rich flotation concentrates; the practice at smelters not using Scotch hearths is still to dilute this feed before sintering. The copper smelter continues to smelt more cheaply and in bidding for difficultly concentratable silver-gold ores, when on even terms as to fluxes and freights, can even underbid the lead smelter on ores containing several per cent of lead, but the lead smelter has an advantage in separating precious metals more quickly. Producers of gold-bearing flotation concentrates cyanide them whenever possible instead of shipping to smelters. There was one contrasting example: the complete lead smelter was erected at Wiluna, Western Australia. In Germany, exchange regulations have caused lead to be recovered from complex residues and from concentrates volatilized from difficultly treatable ores.

Although in 1936 about two-thirds as much secondary lead was produced as primary lead was made from ores, there was too little in the literature on new metallurgy to detail it in this brief review. The importance of the recovery of solders, particularly of tin, continues to be emphasized. Byproducts are being worked up into salable form, such as insecticides and fungicides.

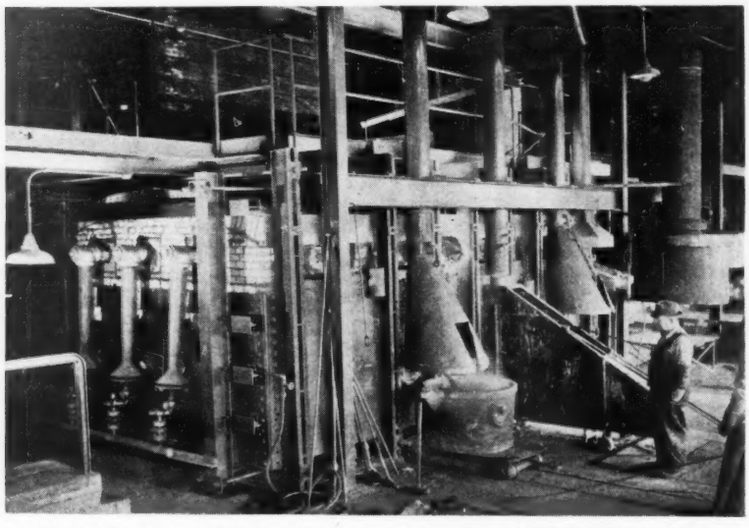
Sintering—But few improvements for sintering rich lead charges have been noted; for such charges diluents are commonly added, and often these are nearly barren.

The changes in the size of sintering machines by several plants are the most radical made since the Dwight-Lloyd machine was commonly adopted. American Smelting & Refining Company has installed pallets 63 in. wide at two Mexican plants (Chihuahua and San Luis Potosi) and at two plants in the United States (El Paso and Leadville). The drop of the pallets has been controlled so there is no shock and no more breakage than with the standard 42-in. pallets. Machine capacity is greater, less unreacted air passes at the sides of the cake, operation is smoother, and less labor and power are needed per ton of sinter. Sinter quality is excellent. The wide machines were introduced for the second roast—now they are used for both. It has been reported that at Port Pirie, South Australia, a machine with pallets 10 ft. wide has been designed. The trend in large smelters then seems to be toward fewer units of greater size or capacity. This holds for sintering machines, blast furnaces, and refineries.

Smeltermen now generally agree that making "quality sinter" is the metallurgist's most effective means of increasing the smelting rate in the lead blast furnace. Ingredients of the charge are now being mixed more uniformly and intimately; where available, lime is used as sand in place of coarser lime rock, and greater care is being used in details of operation, such as adding the correct amount of water and proper bedding on the pallets. In several plants sinter with excellent properties often may be made without adding coke breeze.

However, a good product can be obtained more consistently by decreasing the sulphur content of the "first-over" sinter, say to 4 instead of to about 6 per cent, and then adding coke breeze to the feed of the "second-over" Dwight-Lloyd machines. The final sinter cakes have about the same sulphur content if made by either method—a little over 1 per cent. An "all-sinter feed" for the blast furnace, giving a "pre-digested and pre-reduced" charge, is held ideal.

Blast Furnaces—Clevenger (Trans. A.I.M.E., Vol. 121, p. 45, 1936, Tables 3-6) gave striking data on the Midvale, Utah, plant from 1916 to 1935. In 1916 the blast furnace smelted 232.5 tons of charge per day and made 26.1 tons of bullion. The same furnace in 1935 smelted 472.1 tons of charge and made 153.6 tons of bullion. At other smelters practice was similarly improved and this trend continued in 1937. Some plants are smelting over 500-600 tons of charge per blast-furnace day.



TAPPING LEAD at a drossing furnace at the smelter of United States Smelting, Refining and Mining Company, Midvale, Utah

Some of the increase in furnace capacity of the most progressive plants can be ascribed to improvements in blast-furnace practice as well as in sintering; for example, the better distribution of the ingredients of the charge within the furnace. It is now generally recognized that an excess of coke will slow down a blast furnace. Coke is the most refractory ingredient of the charge. For speed in smelting even the "ideal all-sinter charge," enough coke must be added and burned at a rate rapid enough to secure a high temperature; the charge must also be permeable and the lead reduced and liquated from a rapidly moving stream. It is now common practice in many plants to replace part of the coke with scrap iron—a reducer—and heat may thus be supplied without slowing up the smelting rate.

Operators seeking increased capacity have also found on using high jackets and running the cooling water therefrom at too low temperatures, that enough heat could easily be extracted to drop the daily capacity by 100 tons of charge. Also, on extracting more heat, accretions may build up and cause trouble.

At some smelters with charges that are fusible or rich in zinc that may volatilize and recondense at higher levels, still wider blast furnaces are favored. Those at Trail, B. C., 270x63 in. at the tuyères, gave 30 per cent more tonnage at the start. The furnaces are 84 in. wide, 5 ft. 8 in. above the tuyères: at about this elevation, the sinter passes into a pasty state, fume collects, and the charge tends to form bridges or arches. In the wider furnace the span is greater, the arch is weaker, and there is also a greater weight of charge to break it down. Thirty-six 2½-in. tuyères per side were installed instead of eighteen 4-in. ones to get the greatest area and best distribution practicable for the air. Size of opening in the pasty charge through which air enters is that of the last punch bar forced through, and tuyères much larger than 2½ in. were thought useless. A similar blast furnace 252 x 66 in. at the tuyères was built by Bunker Hill for its lead-rich charge.

A large furnace also has been put into successful operation by Port Pirie. It is 17 ft. long, 5 ft. wide at the tuyères, and the jackets have been curved outward to make the furnace 10 ft. wide at a plane 3 ft. above the tuyères. Double banks of 3-in. tuyeres have been installed, 21 to the side, 10 being at the bottom and 11 on top. (Tuyères were also placed at the ends, but these did not greatly affect the smelting rate.) Heights of smelting column of 16 and 19 ft. have been tried, the blast pressure being 40 oz. and the gas volumes, respectively, 6,000 and 8,000 cu. ft. per minute. The new wider furnace produces from sinter containing 42 per cent of lead, about 190 tons of bullion daily, to 115 tons for the standard furnace 17x4 ft. at the tuyères. The slags contain a little less lead than before, and the furnace has operated smoothly, the charge forming fewer arches. The double set of tuyères gives "top gas," containing little CO. An American plant reached the same end by different means; on using only 9 per cent of coke, the "top gas" contained about 26 per cent of CO_2 and only a few tenths of CO or O_2.

Plants for volatilizing zinc from lead blast-furnace slags at Helena and at Trail operated during 1937, and a similar plant is said to be considered for Port Pirie. With an undiluted feed to the sintering machines, the blast-furnace slags would be richer in zinc, and this metal could be recovered more easily by volatilization.

Refining—Many smelters are trying to control more closely the impurities in the bullion sent to refineries. The attempt is also made to decrease the amount of some impurities sent both to refineries and to other smelters, particularly the ingredients tending to form a circulating lead between copper and lead smelters. Although the selling price of arsenic has been low (3c. a pound), a considerable tonnage has been sold.

Mount Isa bullion is now refined at Northfleet, England (Bull. I.M.M., April, 1937). The recently constructed plant follows a batch system, has a simple flowsheet, and works to a closely timed schedule. In contrast, the large Port Pirie refinery operates continuously. The figures for labor, etc., at Northfleet are not so distributed as to permit comparison with corresponding items from Port Pirie's practice; there are numerous other objections to drawing too close comparisons. Present capacity at Northfleet was given at 72,000 long tons of bullion yearly, or about 222 short tons daily, 50 operators being employed at the entire plant. Port Pirie metallurgists estimated that on the basis of production of 4 to 10 short tons of lead per hour, 37.90 man-days of labor were required per 1,000 tons of lead and 0.623 man-day was needed per 1,000 oz. of silver. (The Port Pirie plant produces 750 tons per day, and it is thought could refine twice as much.)

General experience is that batch systems in many industries give closer metallurgical control but cost more for labor. It would seem that Port Pirie has the advantage in requiring

less labor. Quality of lead made by both refineries would seem to leave little to be desired; the refined product at Port Pirie contains 99.994 per cent of lead, and the Mount Isa product 99.998 per cent. Electrolytic silver from Port Pirie contains 99.97 per cent of silver and the fire-made product from Mount Isa bullion 99.8 per cent.

At Cerro de Pasco a 125-ton refinery employing the Betts electrolytic process is in operation; likewise a bismuth refinery. Much progress has been reported on the use of fire methods to remove bismuth, to avoid use of the more expensive electrolytic process. It is pertinent to note in this connection that another great organization, owning both a fire-refinery for lead at the smelter, and an easterly electrolytic refinery, shipped its bismuth-containing lead bullion to its electrolytic plant, leaving the fire plant closed.

Recovery of Sulphur—Work was continued on some plants on a scale of pilot size. At Trail it was reported that daily production totaled 450 tons of 100 per cent sulphuric acid and 45 tons of elemental sulphur, equal to about 60 per cent of the sulphur received in the feed. This sulphur was recovered from rich SO_2 gases made by "burning" suspended zinc sulphide concentrate in air; however, sulphur also has been made experimentally form the diluter SO_2 gases evolved at the lead-sintering machines (Bulletin, Canadian Institute of Mining and Metallurgy, August, 1937).

Opinion holds that some absorbent for SO_2 should be used—ammonia is used at Trail, the gas going through one tower or several towers in series. One hundred per cent SO_2 may be partly re-evolved from the ammonium bisulphite by heating or more completely by treating it with sulphuric acid before heating. In the first instance, a mixture of ammonium sulphite and bisulphite would be recirculated and resaturated, and in the second the ammonium sulphate would be cystallized out and separated for market. The SO_2, plus some byproduct oxygen from the fertilizer plant to supply heat, is then dried, and passed through incandescent coke to give mostly elemental sulphur, with some oxides of carbon and COS. The mixture of all gases, plus some extra SO_2, is next passed through a catalyst chamber; on cooling the exit gases in a waste-heat boiler, liquid sulphur is formed as a mist. After Cottrell precipitation, to remove some little carbon, 99.95 per cent pure sulphur is recovered.

Part of the 100 per cent SO_2 can be used as feed to the contact sulphuric-acid plant in place of the usual 6 per cent gas, and the capacity of the acid plant is in this manner greatly increased.

Copper Metallurgy

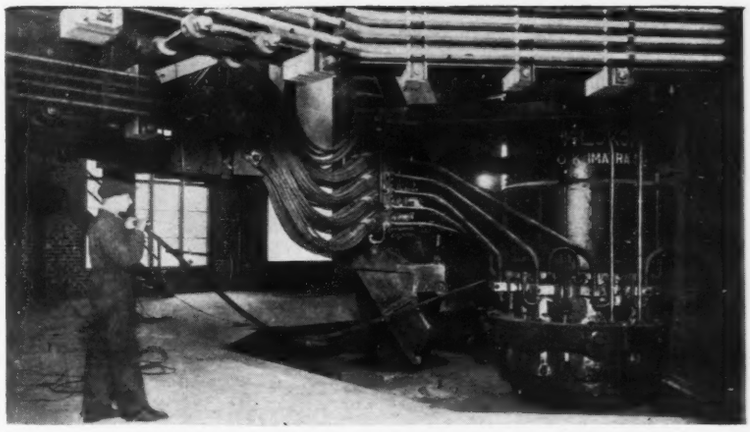
(Continued from page 71)

ing after rehabilitation and is using natural gas, as fuel, for the first time. At Ray, Ariz., a unique and effective plant has been installed for precipitating copper from mine water.

The Chino Branch of Nevada Consolidated is building a smelter to treat its concentrates.

At Lark, Utah, Ohio Copper recently started a new 1,000-ton leaching-flotation plant on a 5,000,000-ton stockpile of tailings containing about 0.40 per cent copper.

United States Metals Refining Company, at Carteret, N. J., has installed a suspended "verb" in its smelting furnace, from which it expects to obtain satisfactory results.



THREE ELECTRODES, each 1.4 meters in diameter, are used in heating the circular reverberatory furnace at the Outokumpu smelter. The current at the electrodes is 100 v. and 50,000 amp.

At Noranda, Quebec, No. 1 reverberatory was lengthened 8 ft. in December, 1936, and No. 2 in April, 1937, this giving improved tonnages. Air pressure at coal burners was reduced to 2 lb. at No. 1 and 5 lb. at No. 2 furnace. During December, 1937, No. 1 smelted 42,231 tons (30.95 furnace-days) and No. 2 42,724 tons (30.93 furnace-days) of solid charge, or 1,364 tons and 1,381 tons of solid charge per furnace-day with fuel ratios of 10.83 per cent and 10.54 per cent wet coal respectively. Both have been equipped with suspended roofs, for 70 ft. from the firing walls, made of 9x4½x2½-in. standard unburned magnesite brick. Much experimental work has been done to simplify the method of supporting standard brick in suspended arches.

Canadian Copper Refiners, Ltd., Montreal East, Quebec, has continued to get its high operating efficiency. In the casting department the most important improvement was in design of the wirebar ladle, not perfected until this year. H. S. McKnight reports "the essential difference between the new and the old is that the new ladle spout and bowl rotate about a common axis in such a way that there is no tilting action and, consequently, the copper in the bowl and in the spout are subjected to a minimum of agitation during casting." Use of this ladle has resulted in better control over the set and a marked decrease in cold sets and edges, so that 337 tons of salable production is produced per charge, instead of 300 tons as formerly. In the silver refinery caustic leach treatment for the roasted slime was introduced. After water-leaching of the slimes they are given a caustic soda leach for removing about 85 per cent of the tellurium; consequently, the amount of metals volatilized during the doré furnace treatment was reduced, together with a reduction of gold and silver tie-up. The caustic liquors are used to leach the soda slags. This reduces the volumes of solutions to be handled and also improves the selenium-tellurium separation in neutralizing. Scrap iron is now used as a flux in the doré furnace, reducing the amount of chemicals required to flux the slimes and the time required to process a doré charge. In the anode furnace, the company has adopted the practice of top-charging of tankhouse scraps during the casting period, which increased the anodes made per charge from 145 to 200 tons. This refinery was originally designed for 65,000 tons of anodes per year. Later it was increased to 75,000 tons and it will soon be increased to 81,000 tons.

All copper refineries are trying to eliminate more impurities so that the final metals may be pure as possible.

Use of cathodes in alloy work increased greatly through 1937, with a corresponding decrease in use of ingots and ingot bars. Scalping of wirebars was introduced on a commercial basis during 1937.

Aluminum Leads Electrometallurgical Field

Interest is world-wide. Work on zinc progresses. 1937 sees numerous important developments in this and other metals

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DEVELOPMENTS in aluminum continue many and world-wide. The industrial countries deficient in reserves of copper ores continued in 1937 to expand aluminum production capacity. Other countries, which are exporting large tonnages of bauxite, are working toward domestic production of the metal. Processes to produce metal from raw materials other than bauxite have been worked out metallurgically, but costs remain prohibitive.

The Aluminum Company of America started a $26,000,000 expansion program. Eventually, capacity of its Alcoa plant will be doubled, but completion is expected to run beyond 1938. Contracts have been signed with the Tennessee Valley Authority for delivery of 100,000 kw. At Arvida, Canada, alumina is being made in part by the Bayer process.

From Germany it is reported that for foil the metal should contain 99.2 per cent aluminum, that care is taken to avoid occluded gases, and that carbon tetrachloride is used during melting. Also, that raw bauxite represents about 7 per cent of the total production costs for aluminum, and therefore aluminum is regarded as a domestic substitute metal, though Germany produces little from domestic ore.

In Italy the Bolzano plant of the Montecatini group installed four pairs of mercury arc rectifiers (one spare set), of 8,000-kw. capacity per pair, for aluminum reduction. The closed type of furnace was built. The Mori plant of the S. I. Nazionale Alumino was enlarged so that this company will have a capacity of 15,000 metric tons of metal per year. Total Italian capacity including expansions is stated to be about 30,000 metric tons of metal per annum, with consumption rated at 10,000.

Hungary's lone plant, Aluminiumwerke Manfred Weiss, near Budapest, started in 1936 and is expected to double its capacity. Electrodes of the Soderburg continuous type, 1x1.3 meters, are used. A current of 13,000 amp. is applied to the furnaces, of which there are 46. Each produces about 80 kg. metal per day. Electrode consumption is 620 kg. per metric ton of alumina, and power at 30 kw.-hr. per kilogram metal. Electric power is generated from brown coal. Hungary is considered by some to have the largest deposits of good bauxite in Europe.

Yugoslavia, another large exporter of bauxite, started a small reduction plant last year near Sibenik, on the Krka River, of a capacity of 1,000 metric tons of metal per year.

Electrolytic Zinc Company of Australasia, Ltd., and the Aluminum Company, Ltd., of England, are carrying forward a large-scale program to produce metal at Risdon, Tasmania, where ample hydro-electric power is available.

Reduction plants are being considered in several other countries, Holland, Czechoslovakia, Austria, Greece, India, Netherland East Indies, and Sweden.

Antimony—Of interest in antimony circles is the fact that Consolidated Mining & Smelting Company, Ltd., of Canada is building a 4-ton electrolytic antimony plant.

Cobalt—Rhokana Corporation, Ltd., added a second cobalt Lectromelt furnace. World demand for cobalt is increasing, especially in bright plating, as a catalyzer, and in carbides.

Copper—The copper refinery (electrolytic) of C. F. des Mines de Bor was built in Yugoslavia under a fifteen-year government concession. The company must guarantee 12,000 metric tons per year and expand to 20,000 m.t. in three years.

Norddeutsche Affinerie, at Hamburg, Germany, modernized and enlarged its refinery. Kromparske Zavody, of Czechoslovakia, installed equipment for a 10,000 metric ton per year plant. About 90 per cent of the U.S.S.R. production is electrolytically refined. Much of the blister carries high precious-metal values. Outokumpu is smelting its copper concentrates in electric furnaces using low cost hydro-electric power at Imatra, Finland.

Lead—Cerro de Pasco's electrolytic lead refinery started last April, producing 50 tons per day. Anodes and cathodes are changed together every four days. Countercurrent dip washing of the anodes recovers practically all acid held in adherent slime. Average acid loss has been kept down to 2 lb. per ton of lead produced. Average assays of bullion and lead in the commercial plant are given in the table:

	Ag Oz/ton	Au Oz/ton	Cu%	Pb%	As%	Sb%	Bi%	Te%
Bullion ...	98.4	0 05	0 10	92 3	2 0	3 4	1 7	0 04
Lead	0.03 (0.0001%)	....	0 0001	99.997	0.0001	0.0004	0 0010	....

The Consolidated Mining & Smelting Company has increased the current efficiency in its refinery by adopting electrolyte purification practice. High-current density operation (up to 18.5 amp. per square foot), started in 1936, was continued.

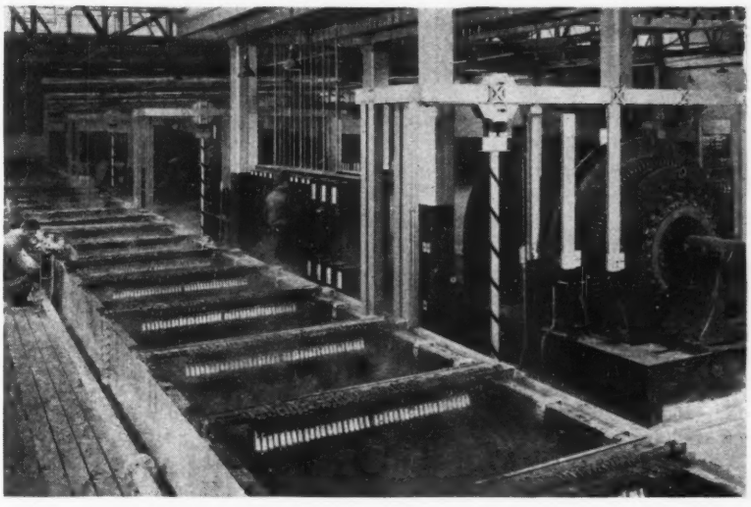
Magnesium—Dow Chemical Company reports improvements at its Midland, Mich., plant. Work is going on in several countries in an effort to use dolomite and a thermal process. The process of the Austro-American Magnesite Company at Radentheim, Austria, is, in brief, to briquet dead-burned magnesite with coal dust and charge into a three-electrode furnace. The magnesium reduces to a vapor and goes into a flue kept filled with hydrogen by jets and at a temperature of 150 to 200 deg. C. The product of magnesium powder and material condensed from the coal is briquetted and charged into a small electric furnace. The magnesium is distilled under vacuum at 750 to 950 deg. C. It condenses in a pipe and drops into oil as pellets. The pellets are melted into ingots. Total power is about 23 kw.-hr. per kilogram of ingot metal. This includes about 4 kw.-hr. to keep up hydrogen requirements in the flue. Total power compares with 25 kw.-hr. per kilogram of metal given for

the commercial German plant electrolyzing magnesium chloride obtained from the carnallite deposits.

The largest German potash producer, Wintershall A. G., is operating the latter process at Heringen. Production is stated to be about 5 tons of metal per day. The carnallite is sorted in the mine and is calcined before being charged to the electric furnace. Eighteen tons of carnallite, which calcine to 10 tons, is required to produce 1 ton of magnesium.

Interesting possibilities are indicated by work showing that reduction of the iron content of magnesium from 0.016 to 0.005 per cent makes the metal more resistant to sea-water corrosion.

Magnesium Metal & Alloys, Ltd., of Essex, England, started production in 1935 and is increasing capacity.



IN THE ELECTROGALVANIZING DEPARTMENT of the Republic Steel Corporation's new wire mill at South Chicago, which was started in 1937. The unit is continuous, 500 ft. in length, and handles 40 strands of wire. After several cleaning and rinsing operations, these pass through the 140-ft.-long electrogalvanizing tank here seen. Photo by courtesy of "Steel"

Magnesium Elektron, Ltd., near Manchester, started metal production last year with a 150 long tons per month basis in view. Both English plants use magnesite as raw material and electrolyze molten chloride.

Nickel—Falconbridge Nickel Mines, Ltd., increased the capacity of its electrolytic refinery in Norway to handle a 25 per cent increase in production. Japan has worked several small refineries, but with operating difficulties more or less unsolved. Companhia de Nickel do Brasil, operating mines near Ayurnoca, in Minas Geraes, built three electric furnaces to treat its garnierite ores, which carry 2.0 to 2.5 per cent nickel. Hydro-electric power was developed for the furnaces.

Tin.—The U.S.S.R. has not had much success in producing tin of standard quality by usual methods, and is reported to have worked out an electrolytic refining method.

Zinc and Cadmium—Electrometallurgical cadmium is largely an adjunct of electrolytic zinc plant operations and is therefore included here. There were numerous developments in electrolytic zinc. Consolidated Mining & Smelting reports further improvement in its suspension, or flash, roasting practice; general adoption of double purification of solution; raising the average grade of zinc produced; increasing the tonnage of 99.99 per cent zinc produced; use of electrolytically plated lead anodes to obtain purer zinc; a material increase in current efficiency. Trail has also been operating lately a semi-commercial electrolytic zinc dust plant on a scale of about 1,000 lb. a day.

In 1933 Hudson Bay Mining & Smelting increased its zinc plant capacity by adding a tenth cell to all cascades of the cell room. Last year it added a fourth unit, raising capacity to 100 tons per day. A cadmium plant also was started to treat the accumulated as well as the present production of zinc plant purification cake.

The Georg von Giesche zinc plant, at Magdeburg, Germany, is being enlarged by 50 per cent and likewise its cadmium plant. The U.S.S.R. program calls for another electrolytic zinc plant in the Altai. Cadmium is being produced along with current zinc operations. Rhodesia Broken Hill, which has one of the two plants operating on oxidized ore, has blocked out a large tonnage of sulphide ore below the oxidized horizon, and is preparing to treat it.

Anaconda's zinc operations were held down by low water and the coincident use of a large block of power in building the W.P.A. Fort Peck dam, in Montana. In addition to its usual work in cadmium, the company is ready to take care of commercial orders for indium. Sullivan Mining is enlarging its zinc plant at Kellogg, Idaho, to a capacity of 100 tons of 99.99 per cent zinc per day. The main part of the expansion that is under way is a third unit of 150 electrolytic cells and the requisite substation extension.

With reference to electrothermic zinc, Trail is operating a 1,500-kw. furnace on dross from the electrolytic zinc plant to produce zinc dust. It has a capacity of 12 to 15 tons of zinc dust per day. St. Joseph Lead operated one of its furnaces at its plant near Pittsburgh to produce 12 tons of zinc per day. A new condenser was developed, with the requisite capacity in one unit. It operates on the principal of drawing the zinc vapor and furnace gas through molten zinc previously condensed. Later two furnaces were put on metal production. Further details of the condenser will be found in the last *Mineral Industry,* Vol. 45.

Electrogalvanized wire has found a ready market. Notable in electrogalvanizing work was the starting of the new wire mill of the Republic Steel Corporation at South Chicago. The electrogalvanizing department is a continuous unit about 500 ft. long and handles 40 strands of wire continuously. The wires are successively passed through baths of molten lead, hot alkali, and pickling solution, with the necessary rinses. Final cleansing is done by an electrolytic flash cleaner, which etches the surface to promote a tighter bond between iron and zinc. After more rinses the wires pass into the electrogalvanizing tank, 140 ft. long, 6 ft. wide, and 2 ft. deep. Zinc solution flow is countercurrent to the wire travel. High-grade zinc anodes are used instead of insoluble lead anodes as in the Bethlehem Steel Company operations. The wires travel 35 to 70 ft. per minute through the tank, with current densities up to 1,500 amp. per square foot of wire surface. Four plating motor-generator sets (each good for 20,000 amp. at 7v.) and two small flash cleaner sets supply the direct current.

Electrogalvanizing operations of the Bethlehem Steel Company were discussed in my article of February, 1936. Operations have been practically at capacity since then until, possibly, recently. Much work was done during the twelve months on the problem of electrogalvanizing sheets commercially.

I wish to express my appreciation to all who have contributed to make this article more than a "rehash" of the year's literature, especially S. G. Blaylock, S. K. Colby, Stanly Easton, Harold Kingsmill, Republic Steel Corporation, and the United States Bureau of Mines.

Minor Metals Have Unusual Year

Markets affected by world events and active industrial demand. Steps taken toward creating emergency stockpiles

The Metal Economics Division

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IN MANY WAYS 1937 was an exceptional year for minor metals. Production usually exceeded peace-time records, and in some instances new highs were set. Demand likewise was unusually high, particularly in the first quarter, but as the industrial pace slackened in the closing months, consumption fell sharply, and at the year's end production exceeded current requirements considerably.

Markets were dominated largely by political events abroad. Early in the year prices were carried upward by the speculative boom in London, precipitated by announcement of the British rearmament program in 1936. National defense and self-sufficiency were in the forefront. Civil war in Spain threatened a shortage of mercury, and Japan's invasion of China caused similar concern for antimony and tungsten. Net effects, however, were not as drastic as expected. Increased demand for ferro-alloying minerals for munitions actually led to world search for new sources. Large imports of these minerals, when measured against the index of industrial activity, suggest that domestic consumers were building up stocks. Prices at the year end in general were higher than at the beginning but much below the highs of the intervening months.

Antimony—The market, in contrast to 1936, was characterized by wide fluctuations. The London boom contributed largely to the abrupt rise of domestic metal from 13.75c. per pound on Jan. 1 to 16.50c. on March 1, but with its collapse, prices settled to about 14c. early in July. During this period, however, Chinese metal was relatively scarce, as the Antimony Administration, which on Jan. 1 assumed rigid export control, established prices much above those elsewhere. This situation was aggravated by the Japanese invasion. In August river shipments from the producing areas ceased, precipitating another price flurry. By Sept. 30 the domestic price had risen to 17.375c., but with the sharp recession in activity in the closing months and resumption of shipments from Changsha via Hongkong, prices fell sharply and at the end stood at the same level as at the beginning.

Higher prices have stimulated domestic output, but imports continue to supply most domestic consumption. The Laredo smelter operated all year at about half capacity. Smelter ore supply was ample at all times to meet trade demand, although labor unrest in Mexico was troublesome. Imports for the first ten months were about 25 per cent above those for 1936, indicating that apparent consumption will approximate that of 1929.

Arsenic—An estimated 10 per cent increase in domestic output and a like increase in imports of white arsenic indicate that apparent consumption reached an all-time peak in 1937. Increased consumption, however, was not enough to offset the depressing effect of large excess production of smelter byproduct, particularly in Sweden, and prices fell. Domestic quotations for white arsenic were reduced from 3½c. per pound to 3c., the lowest since 1914. Quotations for some arsenicals, however, advanced from abnormal lows of 1936.

Bismuth—Statistics on domestic and world production are not available, but substantial increase in production is indicated by the general increase in smelter activity. Pharmaceuticals continue to take about 75 per cent of all bismuth consumed. The low-melting-point and non-shrinking alloys, next in importance, are using more bismuth each year, but much of the metal is reclaimed. The price for metal remained unchanged at $1 per pound in New York and 4s. in London throughout 1937. Imports of bismuth metal totaled 57,225 lb. in the first ten months, compared with 113,443 lb. in all 1936. Large quantities are imported in base bullion and other alloys, chiefly from Peru.

Cadmium—Demand continued to exceed production, with consequent tightness in supplies and higher prices. No large increase in domestic production is anticipated, but imports were decidedly higher, amounting to 691,000 lb. of metal in the first ten months, compared with 576,000 lb. for the entire previous year. An appreciable increase in domestic consumption to a new record high is thus indicated. Approximately 1,000,000 lb. is estimated to have been used in bearing alloys alone. Potential use in this field is large, but lack of a dependable source of supply restrains many manufacturers from adopting cadmium bearings.

Under the impetus of heavy demand, prices rose from 75c. per pound to $1.25 in June, this figure holding for the rest of the year. Spot metal was scarce most of the year, some sales being made at over $2 per pound. For platers' shapes the net change was from $1.05 in January to $1.60 later in the year. Effective Jan. 1, 1938, all prices were reduced 25c. per pound. American Steel & Wire began to produce cadmium during the year. Montecatini, in Italy, is building a new 100-ton-per-year plant.

Chrome—Apparent consumption of chrome ores in the United States in 1937 ran far ahead of any preceding year, indicating the high rate of steelmaking activity and increasing use of chrome steels and irons. The high rate of imports, running 65 per cent ahead of 1936, suggests that consumers were stocking up against emergencies. Aside from larger takings of Rhodesian and South African chromite, the receipt of 35,048 long tons from the Philippines, a new source, is of interest. Southern Rhodesia has resumed its place as the leading producer but is being pressed by Turkey and U.S.S.R.

Prices continued upward and at the year end domestic journals were quoting imported ore (50 per cent grade) at $26 per long ton. Spot supplies have been scarce.

As a result, domestic production will probably exceed that for any year since 1920. Much activity in exploration was reported, particularly in the Coast States.

Late in the year the Navy Department asked for bids on a limited quantity of chromite. The ore will be stocked at the Philadelphia Navy Yard for emergency use.

Cobalt—World production prob-

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ably set a new record in 1937, despite an indicated decline of over 35 per cent in Canada's output and reduced exports from French Morocco. Canadian production for the first nine months totaled only 400,000 lb., compared with 645,000 in the same period of 1936, due to depletion of surface dumps at Cobalt, heavily drawn on previously. Details from the Belgian Congo are not available, but increased copper output by Katanga suggests a substantial rise in cobalt production. In Northern Rhodesia, Rhokana reported a sales increase from 925,000 lb. during the fiscal year 1935-1936 to 1,459,000 lb. in 1936-37.

Demand continues to expand. Tool makers were active customers, particularly in Europe, and use of cobalt in bright plating and as a catalyst is increasing. Introduction in Germany of cobalt and thorium in catalysts for synthesizing gasoline is of interest. The New York price for quantity lots rose from $1.25 per pound to $1.36 in September.

The United States continued to rely almost entirely on imports for its supply, figures for the first ten months indicating a 15 per cent rise. Sharp decline in ore shipments from Canada was more than offset by larger purchases of metal, chiefly from Belgium, and of oxide.

Magnesium—Production has increased in late years, and although annual world output has been placed as high as 50,000 metric tons, it is likely to be less than half that. A German paper recently estimated 1937 world production at 25,000 tons of metal, powder, and alloys.

Virtually all past production has come from electrolysis of magnesium chloride, using magnesite, dolomite, brine, or carnallite as raw material. Possibilities of the new Austrian process whereby much purer metal is obtained by electrothermic reduction of magnesia by carbon have been demonstrated and patent rights for England and Japan have been sold to firms in those countries. In the United States success has been had in increasing the corrosion resistance of magnesium alloys in salt-water atmospheres. Cooperative study by the Bureau of Mines and the State of Washington Electrometallurgical Laboratories suggests the feasibility of making magnesium with power from Bonneville and Grand Coulee and utilizing Washington magnesite, especially the quarry reject that is not good enough for dead-burning magnesite. The New York price remained nominally at 30c. Increasing production abroad has cut into our export trade, formerly an important factor in the domestic industry.

DEMAND FOR TUNGSTEN exceeding supply in 1937, domestic mills ran at full capacity, although on lower-grade ore. New properties were sought and old mines reopened. At least three new plants were under construction. Here is a new custom tungsten mill at Toulon, Nev.

Manganese—World sources of manganese ores felt the pressure of increased demand. Steel production ran ahead of expectations, and the quantity of manganese used per ton of steel seems likewise increasing. Supplies were tight and prices of imported ore for domestic delivery doubled in some instances. Demand for domestic ores was better, but no large operations were begun, although several small properties began producing. Increase in domestic output was due largely to greater activity in Montana, where production of sintered rhodocrosite at Butte was revived actively.

Domestic output, however, fell far short of requirements, which undoubtedly reached a new peak in 1937. The larger demand was met by record imports, which for ten months were 849,323 long tons—more than for all of 1936. The U.S.S.R. continued the most important source. Total Russian exports in the first nine months were 85 per cent higher than in the same period of 1936. In Cuba, the production and the shipments of ore increased.

Bids were asked by the Navy in October for a limited tonnage of manganese ore or low-grade ferromanganese for a proposed stockpile. Those received were rejected because the material was not deemed satisfactory. Specifications are being revised.

Mercury—Civil war in Spain, armament programs, and general speculative activity created unusual demand in the latter part of 1936 and early in 1937. From Oct. 1, 1936, to April 1, 1937, the United States imported 18,000 flasks—much more than the previous annual average. Higher prices stimulated activity at operating mines and several new properties here began producing. By the middle of 1937 it was apparent that only unusual consumptive requirements could absorb the quantities available, and, this failing to develop, prices declined sharply. Imports in the latter months fell and at the year's end domestic mines were running at only a small part of their capacity. Indications are that the high activity early in the year was offset by a recession in production subsequently and that domestic output for the year will be lower than in 1936.

Information is not available as to production in Spain, but the unusually large imports of mercury into consuming countries in 1937 indicate that much of it must have originated there. Italy's output increased sharply but was insufficient to account for all of the gain in world supply. Italy was reported to have produced 39,700 flasks in the first seven months, compared with 42,700 flasks in all of 1936, and exports were 58,100 flasks in the first ten months of 1937, compared with 41,400 in all of 1936. The United States imported 18,902 flasks in the first ten months of 1937, compared with 18,088 in all of 1936.

Molybdenum—World output touched a new high, due largely to the record output of American mines which furnish most of the supply. Demand was strong at home and abroad, and the principal domestic producer, the Climax mine, was pushed to meet orders. It more than doubled plant capacity, starting its new mill in March, and subsequently treating more than 10,000 tons a day. Its output totaled 22,600,000 lb. of molybdenum. Utah Copper is now the second largest world producer of molybdenum concentrates, which are recovered by flotation at Magna and Arthur mills. The ore as it comes from the Bingham copper mines is said to contain about 0.05 per cent molybdenite. Molybdenite is being produced experimentally by Kennecott at Hurley, N. M. Other supplies are coming from several smaller producers. The total domestic output in 1937 may reach 30,000,000 lb. of molybdenum.

(*Continued on page* 79)

Air Conditioning Gets Increasing Attention

Use of conveyors and trucks for open-pit transport, and changes in stoping methods, also feature advance in mining practice

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AIR CONDITIONING is receiving more attention from the mine operator than ever before. The three most recent installations for conditioning mine air are of different types, two of them being the first of their kind in the United States. They are: (1) Surface cooling plant—no compressors or artificial refrigeration machines—at one of Anaconda's Butte mines; (2) an underground installation of a mechanical refrigeration unit at the Magma mine, Arizona; (3) a surface cooling and dehumidifying mechanical refrigeration plant at Robinson Deep, Ltd., in South Africa.

Average annual surface temperature at Butte is about 40 deg. F., with low relative humidity in summer months, making available unlimited natural cooling power. The system comprises a surface tower which cools either water or brine circulated in a closed circuit to an underground air-conditioning plant near the working zone. The air is forced by fan through coils containing the cooling medium. The water or brine with absorbed heat is then returned to surface. Results show a change from an average condition of 86 deg. F. dry bulb and 83 deg. F. wet bulb in fourteen working places to 80.5 deg. F. d.b. and 78 deg. F. w.b. It is hoped to reduce the average mine air to 75 deg. F. with 75 per cent r.h. Forty-six per cent of the dust in entering air is removed by condensation of moisture in cooling.[1]

Rock temperatures at the Magma mine are 109 deg. F. at the 2,000-ft. level and 140 deg. F. at the 4,000-ft. level. The first mechanical refrigeration unit was started July 19; the second Aug. 3. Total cost including excavation was $94,707.85. The units used are two Carrier centrifugal compressors of 140 tons' refrigerating capacity each. Actual production is 220 tons under adverse conditions. Average condition of eight places on the 3,600-ft. level before installation was 92.75 deg. F. w.b., 101.4 deg. F. d.b., 72 per cent r.h., giving a mean effective temperature of 92 deg. F. Twenty-eight days after starting the plant, average conditions in the same place were 84 deg. F. w.b., 92.75 deg. F. d.b., 69 per cent r.h., or a mean effective temperature of 85 deg. Results are satisfactory.[2]

At Robinson Deep's Turf shaft three Carrier centrifugal refrigeration machines were installed recently with the same number of surface accessory units. The plant will cool 407,000 c.f.m. from 65 deg. F. w.b. to 380 deg. F. dew point. At 5,900 ft. below the collar the temperature has fallen 9 deg. F. to an average of 66 deg. F. w.b.[3]

A new "world's deepest mine" has developed in No. 15 B shaft of Crown Mines, Robinson Deep. It is 8,527 ft. below surface. A vertical depth of 10,000 ft. is thought possible with air conditioning.[4]

New modifications and adaptations of old stoping methods are noted. The Montreal mine, on the Gogebic iron range, Wisconsin, has modified the sublevel-caving method, increasing the vertical interval between sublevels from 20 to 25 ft. to 50 ft. Two adjacent headings on the sublevel, 25 ft. apart, are carried from foot to hanging simultaneously; also an untimbered manway between them and 25 ft. above the sublevel. On reaching the hanging, the headings are connected with the manway by raises, and mining is begun from the manway as in sublevel stoping, save that the back caves as the opening is enlarged. The stope thus made is enlarged until the ore caves to the old sublevel above and is withdrawn through the raises. Small stopes are also opened up from both sides of the headings, as usual in Gobegic sublevel caving, to cave the ore left outside of and below the stope opened from the manway. This is continued on retreat toward the footwall. Because of the greater sublevel interval, less timbering is needed, and the two operations, breaking ore and scraping, may proceed independently of each other.[5]

The Sunrise mine, at Sunrise, Wyo., operated by the Colorado Fuel & Iron Company, using the block-caving system, controls the weight on development openings by novel means. Ores mined are a hard, massive hematite and a soft, sticky, schistose variety. In mining the soft ore, cutting off the block entirely by shrinkage stopes threw so much weight on development openings that the grizzly drifts could not be held. This has been overcome by drifting along the block boundaries at intervals of 40 ft. in elevation. The bottom 40 ft. is cut off by a shrinkage stope, but above this elevation holes are drilled and blasted from the cut-off drifts, both top and bottom, leaving 20 ft. of solid ground alternating with 20 ft. of loose ground. The ore arches between boundaries, works up gradually from the center, and squares itself when the blasted ore is reached. Thus the weight on openings is reduced.[6]

At the Noranda mine, Quebec, 75 per cent of the mining is done by sublevel stoping. Mining during 1937 was nearly all done by the bench method in stopes previously prepared, but all the newer stopes are planned for mining from drifts instead of benches. In the sulphide stopes, holes 15 to 20 ft. deep are drilled with jointed steel. In the large siliceous flux stopes, 80 to 100 ft. wide with sublevel drifts 50 ft. apart, all drilling will be done with diamond drills from these drifts.[7]

The Golden Queen mine, at Mojave, Calif., is using a flexible combination of stoping methods, called the "slot system," in the wider parts of the vein where the back is not sufficiently self-supporting for shrinkage. The "slots" are square-set stopes, a set wide, extending from foot to hanging and from level to level at 25- to 35-ft. intervals along the vein. Pillars between "slots" are mined normally by shrinkage. If the ground proves insufficiently self-supporting, the ore already broken is withdrawn, the stope filled, and the remaining ore mined by cut-and-fill. If this method gives trouble, the fill is leveled and straight square-set stoping used. The "slots" are open during the mining of pillars, are used as manways and ore chutes, and later as waste chutes for filling.[8]

An outstanding example of a combination of newer methods of handling materials in open-pit mining may be

found at the Spruce iron mine, on the Mesabi range. The orebody is 80 to 90 ft. thick along the center of a wide, flat trough. Along the bottom of the ore in this trough is a small drift in which is operated a belt conveyor system. Three raises, 500 ft. apart, extend vertically from this drift to the top of the ore in the pit. Two of them are fed with tower power-scrapers, or slackline cableway excavators, with an average operating radius of 170 ft. and a clean-up radius of 700 ft. The towers are 100 ft. high and mounted on a 30-ft. diameter track around the raise. The scrapers hold 3 cu.yd. and are hauled with a 125-hp. motor. Average hourly handling capacity is 100 tons at 350-ft. radius. The third raise receives ore loaded by electric shovel into 20-ton end-dump trucks which deliver it to the raise. At the top of each raise is a crushing and screening plant, essential to conveyor transportation. The belt system is the longest yet used in iron mining, being 4,500 ft., with a net vertical lift of 386 ft. About 70 per cent of the system is underground, the belt line then emerging above surface to deliver the ore to a pocket for loading railroad cars. Speed is 500 f.p.m. and handling capacity 750 long tons per hour.[9]

Large tractor-powered scrapers have been used in the Middle West as an aid in opening box cuts in deep overburden and for miscellaneous earth-moving jobs.

New ore-transport methods were recently installed in the St. Paul open pit of the Republic Steel Corporation, at Keewatin, Minn. The system consists of a belt conveyor line, fed by trucks, which line runs from the bottom of the pit to a railroad bin at the top of the bank. Two-way dump trailers of 13-cu.yd. capacity are loaded by two 1¼-cu.yd. gasoline-engine driven shovels and hauled with tractor trucks to a screening and crushing plant which feeds the conveyor system. The conveyor line is 900 ft. long, in three 284-ft. sections, each of which operates at 19 deg. to the horizontal. The system can handle 250 tons an hour.[10]

The Bureau of Mines has issued its fourth progress report on its investigation of detachable bits. Conclusions based on data from 28 metal mines are: rock drilling is an individual problem at each mine; success or failure depends not only on the bits but on the quality of the shanks; the development of rods has not kept pace with the bits; if the life of the bit, including use after reconditioning, exceeds 10 ft., its use is almost certain to prove advantageous, but if it is less than 4 ft. there is little prospect it will prove economical; between 4 and 10 ft. there must usually be some special condition to warrant the change to detachable bits.[11]

Although progress is being made in safety educational work, statistics of the National Safety Council show that mining still has the highest accident rate of the major industrial occupations in the United States. Of 30 main industries, the average number of accidents per thousand employed is 1.58. Mining heads the list with 10.14. Statistics on mine safety, however, show that if all mines were as efficient in accident prevention as possibly 10 per cent are, accidents could be reduced 90 per cent; also that there is not a single main cause of mine accidents that has not been solved by several mines or mining companies.[12]

FOOTNOTE REFERENCES

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[7] *Canadian Mining and Metallurgical Bulletin* (March, 1937), pp. 141–164, and private communication.

[8] A. I. M. E. Technical Publication No. 775 (1937).

[9] *Skillings' Mining Review* (Oct., 16, 1937).

[10] *Engineering and Mining Journal* (December, 1937), pp. 50–51.

[11] Bureau of Mines Information Circular 6951.

[12] Bureau of Mines Information Circular 6958.

Minor Metals

(*Continued from page 77*)

Platinum Metals—With nickel mining in the Sudbury district, Ontario —now the chief source of platinum metals—at an unprecedented rate, the output of platinum metals was undoubtedly correspondingly greater. World production in 1937 (outside of Russia, for which authentic information is lacking) thus probably exceeded the record output of approximately 356,000 oz. made in 1936.

A modern dredge started work in the Goodnews Bay district, Alaska, Nov. 10. Introduction of dragline excavators three years ago resulted in an increase in annual output from a few hundred ounces to nearly 8,000 oz. Dredging is expected to raise it to 40,000 oz. per annum.

Heavy demand for refined platinum in the first six weeks boosted the price from $48 to $68 an ounce, effective Feb. 1. Later, as demand failed to keep pace with supplies, reductions were made, and on Dec. 7 the price fell to $38. Palladium was quoted at $24 throughout 1937. The price of iridium reached a peak of $138 in February, but declined to $90.

Progress of platinum metals in recent years has been remarkable and is evidence of effective research in developing larger, more diversified markets to absorb the increased output from higher nickel production in Canada.

Tungsten—Inasmuch as more than a third of the world's tungsten comes from China, the undeclared Sino-Japanese war threatened to cut off a large part of the supply. This together with unusual demands in industrial nations caused the price to skyrocket. Quoted prices for domestic scheelite more than doubled, reaching $35 a short ton unit in September. In spite of the conflict, exports from China amounted to 14,496 metric tons in the first nine months, compared with 4,942 tons in the same period of 1936. Supplies, however, were tight, and assurance of delivery was difficult to obtain.

Imports for consumption into this country the first ten months of 1937 were 4,252 short tons containing 2,599 tons of tungsten, more than double the corresponding 1936 figure. Sixty-nine per cent of the 1937 imports came from China.

In the United States, mills ran at full capacity but on lower-grade ores, so that a decline in output is looked for. New properties were prospected and developed, old mines reopened, and old dumps reworked. At least three new mills were under construction. United States Vanadium Company built a 250-ton-per-day plant at Pine Creek, near Bishop, Calif.; Nevada Tungsten Corporation a 100-ton mill near Gardnerville, Nev.; and Tungsten Corporation of California a 150-ton plant near Benton Mills, Inyo County. New equipment doubled plant capacity of Ima Mines Corporation, May, Idaho. As a result of such developments, domestic output is expected to increase in 1938 if prices hold up.

Tungsten is another of the strategic minerals that the Navy Department is stockpiling. Specifications have been prepared and the schedule will call for bids early in 1938.

Vanadium—Supplies responded to pressure of increased demand. In the United States, imports of vanadium in ore, all of which came from Peru, were 522 tons for the first ten months, compared with 153 tons in the same period in 1936. New Developments at home may go far toward making the country independent of foreign supplies. Among these, United States Vanadium Corporation completed a new plant at Uravan, Colo., to handle low-grade carnotite fom Paradox Valley, which supplied ore to the domestic radium industry before it collapsed in 1923. The first carload was shipped early in 1937. The company is to double its capacity. Reserves are said to be sufficient for several decades. Purely nominal quotations for ore were unchanged throughout 1937 at 27½c. per pound for contained V_2O_5.

Ore Dressing

(*Continued from page 67*)

sidered to approach the ideal more closely than any heretofore available (A.I.M.E. Tech. Pub. 605; also Bureau of Mines, R.I. 3333).

Collectors — In sulphide flotation, xanthates and other water-repelling, insoluble, metal-salt formers have been unexcelled. There are examples, however, where addition of a coal tar or shale tar, instead of or when used in conjunction with xanthate, has improved recovery. Combinations of xanthate and oleic acid have been used to increase recovery where both sulphide and oxide minerals exist. Oleic acid in properly modified and conditioned pulps is the leading collector of non-sulphide minerals. Selective oiling of such minerals as zircon in beach-sand products (zircon, rutile, monazite) with fatty acid radicals in solutions of low pH, followed by removal of excess flotation reagents, by decantation and washing, is a "managed" oiling process and one of considerable interest.

Oleic acid, an anionic oiler, often gives much better results when used with a cationic oiler. Interest and activity in this field are indicated by the large number of patents being issued.

In dilute solution, these reagents are nearly completely ionized. Dean (ref. cited) divided them into two classes represented typically by (1) the alkali metal salts of the higher alcohol sulphates or the long-chain aliphatic acids, which give large lipophile negative ions, and (2) the heavily loaded quaternary ammonium salts, which give large positive ions. These reagents generally speaking, possess three properties: (1) they are frothers; (2) they are emulsifiers of insoluble oils and aliphatic acids, and as such are dispersers and carriers of mineral collectors; and (3) they—those ionizing to give positive ions (reagents of Class 2)—are collectors of minerals such as quartz, feldspar, barite, fluorspar, and calcite, the suspensions of which in water are negative.

These pure reagents, unlike such frothers as pine oil, cresylic acid, phenol, etc., which unexplainably (Fahrenwald and Newton, Ms. in hands of *E.&M.J.*) have mild collector properties of sulphides, possess no such capacity.

Chemical or ?—A mild controversy goes on and a slight difference of opinion exists in flotation schools of thought. Those interested in taking sides are referred to the recent most able articles of Taggart and his associates ("Oil-air Separations of Non-sulphide and Non-metal Minerals," A.I.M.E. T.P. 838, 1938), Wark and his colleague ("The Physical Chemistry of Flotation," IX, *Jour. Phy. Chem.* 41, 1937), Dean and his collaborators ("Use of Wetting Agents in Flotation," Bureau of Mines, R.I. 3333, 1937), and D. A. Shoedov (Gorno-Obogatitel. Zhur No. 6, 1936).

The chemical hypothesis holds that the surface reaction is one of metathesis and that stoichiometric quantities of reagents are involved in the reactions. The other point of view is that the reactions are chemical in kind—i.e., the forces involved are ionic in character and electronic in origin, or the valence bonds involved are secondary in kind, but not necessarily stoichiometrically complete. By the chemical hypothesis, say, in the case of galena flotation, the mineral coating of insoluble, water-repelling, lead xanthate is the result of first an oxidation reaction to produce lead ions on the galena surface. There then follows, through a chemical reaction, the formation of lead xanthate. The stoichiometric counterparts of Pb^{++} and of xanthate ions are in solution. There is much evidence in favor of a chemical theory and much against it.

Solubilities of minerals, solubilities of minutely soluble precipitates, solubilities of salts of promoters, the profound effect of pH on solubilities of minutely ionized and minutely soluble substances, all are so obviously involved that one should become hopelessly lost and incapable of attacking any difficult problem if one did not view the problem in a chemical light. Certainly, the old concepts of adsorption are of little or no value.

Depressants—Headway has been made in application of depressants, both to sulphide and to non-sulphide mineral flotation. The chemical mechanism involved in many cases still is uncertain. Depressants almost invariably are salts of weak acids. They have a dispersing capacity of certain minerals, and it appears that this capacity is related (1) to the minute ionization of these acids, and (2) to the high insolubility of many of their base-metal salts. Their depressing properties lie in their capacity to affect both the ionic state and the surface solubility of mineral particles. Phosphate (W. T. McDonald, *Min. and Met.* 18, 285-6, 1937), used many years ago as a depressant of sphalerite; cyanide, and sodium sulphide (A. S. Saldkov, Tsvetnye Metal, No. 1, 66-80, 1936), an old sphalerite depressant, particularly have been mentioned. pH is a dominant factor in the successful use of depressants.

The pH Factor — The potency of promoters and flotation modifiers is largely determined by the pH factor. This may be easily experimentally shown for a great variety of reagents. For any mineral, any xanthate (or other promoter) and any given concentration of a modifier reagent, recovery generally will fluctuate over a wide range with variation of pH. Undoubtedly the explanation is to be found in the change of solubility, of whatever surface substance may be involved with variable pH. Gaichi Yamada and Kuyoji Naganuma (IX, Suiyokwai-Shi 9, 197-209, 1937) found that the flotation of marmatite is from 60 to 96 per cent in solutions of pH lower than 5.7, and that it gradually decreased to 1.8 per cent at pH 11.2. Gaichi Yamada and Yukie Yokoyama (Suiyokwai-Shi 9, 245-50, 1937), using a white camphor oil, found that in the flotation of stibnite there were two critical pH values, at 4.0 and at 7.1. With camphor oil and potassium ethyl xanthate, there was one critical pH at 6.5, and the floatability of stibnite was markedly increased in the range 4 to 6.5. $CuSO_4$ depressed the floatability of stibnite in the pH range 4 to 7.4. KCN depressed stibnite in the pH range of 3.5 to 7.0.

Fahrenwald and Newton (*E.&M.J.*, Jan., 1937, p. 23) found that for quartz, using oleic acid as collector and various heavy metal nitrates as activators, flotation recoveries were nearly nil at pH values 1.5 to 3.5; passed through maxima at 3.0 to 6.5, and were again nil at 7.0 to 9.0.

Relatively little is known of the effect of pH on all classes of flotation reagents. It is a fruitful field for research, and much may be expected.

Flotation of Near Colloidal Sizes—Loses still are high at many plants in fine (minus 18 to 10 microns) flotation tailings. Neither a workable explanation nor a solution of the problem has been forthcoming. Although I know that studies in this field have been and are under way, there is no recent literature. It has been surmised that in grinding operations the small particles in the product are older than the larger ones, and that therefore they are oxidized and in turn, because they are more oxidized, they are less floatable. Proponents of the chemical theory advance the hypothesis that surface oxidation of a sulphide precedes and is a prerequisite for xanthate flotation of that sulphide. One or the other, or possibly both, of these theories is wrong. Inasmuch as, in flotation, the solubility factor is a dominant one, and inasmuch as the solubility of a particle and its size, or the solubility of a feebly soluble coating (hydrophil or hydrophobe) and the curvature of the surface in question is a variable, particle size is a natural factor entering into flotation. The greater intensity of ionization of smaller particles is another factor. Research in this field is extremely difficult and correct deductions from experimental data are hard to make.

Highlights of 1937 Equipment

Mining industry well served by manufacturers' desire to improve products through research

H. C. Chellson

Assistant Editor

NEW ALLOYS developed through the steel, nickel, and welding industries are finding a ready market among equipment manufacturers seeking to improve their products. Mine operators are, therefore, offered new opportunities to obtain equipment that will improve efficiency and permit operations on low-grade ores and still keep men at work when metal prices reach low levels and taxes continue high. Manufacturers of electrical products are constantly improving their service with new devices, such as demonstrating the application to industry of the photoelectric cell, the radio-telephone for remote mining regions, and numerous new control systems. Mechanization in metal mining, such as underground conveyor belt systems for ore transport and the growing use of slusher hoists, is receiving more consideration than before. Efforts to reduce dust hazard are demanding intelligent consideration by state legislatures. Meanwhile, manufacturers and mine operators carry on their own research in health and safety-first programs. Cooling air at the Magma copper mine, in Arizona, by an air-conditioning system, indicated an important trend in the mining industry during 1937. Latest equipment and improved devices of interest to the mine, mill, and smelter operator are briefly described herewith.

Rock Drills—Among new drills announced during the year by Ingersoll-Rand, Phillipsburg, N. J., was the JA-55, designed for drilling hard rock and deeper holes. The machine is heavier than the JA-30 and JA-45 models which the company recommends for general drilling. The Ingersoll-Rand DA-30 and DA-35 were introduced for extra-heavy down-hole work, where a combination sinker and mounted drifter is desired, simply by running the drifter out of the shell and attaching the sinker handle to the through-bolts. The company's FM2 wagon drill was designed to meet requirements of the largest drifter drills which it produces.

Independent Pneumatic Tool Company, Chicago, Ill., announced as its greatest recent improvement the design in the Thor short travel, positive tubular valve that is said to cut in and out quicker, permitting a precisely governed, unvarying quantity of air in back of the piston hammer.

The Cleveland Rock Drill Company, Cleveland, Ohio, announced as its contribution to more efficient drilling equipment for drifting a new line of

AUTOMATIC-FEED drifter of Cleveland Rock Drill Company

three automatic feed drifters, AD77, weight 140 lb.; AD12, 170 lb., and AD14, 210 lb.

Gardner-Denver Company, Quincy, Ill., announced its AF-89 motor-feed drifting drill, weighing 185 lb. The power from an air-driven piston is transmitted to the feed-screw nut of the drill and the feed screw is held

GARDNER-DENVER motor-feed drifter drill weighing 185 lb.

stationary. Advantage of this machine is said that it does not utilize vibration but advances the drill steadily forward regardless of vibration.

Conveying or Material Handling—Belt conveyor and allied equipment continues to occupy an important place in mills for handling crushed ore, waste, and concentrates. During the past year, however, its versatility became better known as it replaced the conventional method of hauling ore in mine cars. Long accepted in the coal-mining industry, belt conveyor systems underground for transporting ore are receiving greater consideration by metal mine operators. Instance of one large installation is the LaRue mine of Butler Brothers on the Mesabi range, Minnesota, where ore flows continuously for 4,440 ft. to a railway shipping bin, of which 2,135 ft. runs underground and the total vertical lift is 385 ft. handling 400 tons of ore per hour.

Among manufacturers that have improved equipment in this line is the Chain Belt Company. Its style No. 32 Troughing Idler has Timken-equipped interchangeable rolls supported on unbreakable malleable-iron brackets and equipped for high-pressure grease lubrication. Dodge Manufacturing Corporation, Mishawaka, Ind., announced an idler equipped with ball bearings that are factory sealed and prelubricated. An all-welded steel pulley designed for 120-lb. effective belt tension per inch width of face was also announced by the company.

The Philips Brand self-guiding conveyor belt was announced by Link-Belt Company, Chicago, Ill. The feature of the design is the conveyor belt has a molded continuous center guide strip on the underside, and the use of antifriction conveyor idlers having a central roll with a deep groove within which the guide strip is confined in both runs. Among the new mine-car loaders announced during the year was a new model by Gardner-Denver Company, Quincy, Ill. Eimco Corporation, Salt Lake City, Utah, added to its line of loaders Model 12, said to offer many advanced features such as gear drives, automatic clutch for free wheeling, and greater capacity.

Ore Haulage—Difficulty in maintenance of small industrial railroads and high cost of railroad and highway construction to remote mining regions have made tractors, large-capacity trucks, and various types of earth and rock transport equipment more common sights around many mines. During 1937 R. G. LeTourneau, Inc., Peoria, Ill., added Model U to its line of Carryalls. It has an expanding bowl consisting of two buckets. For long hauls two Carryalls can be operated in tandem hook-up behind one tractor. The company also announced a 15-cu.yd. all-welded buggy, designed particularly for hauling ore or gravel either short or long distances. A feature when dumping is

that the body moves backward over the bed, pushing the load through to an ever-widening opening to the rear. Caterpillar Tractor Company, Peoria, Ill., determined from its research improvements by the use of certain metals, that are said to result in longer service for replacement parts. Mine operators in Alaska say tractors are doing invaluable service in developing mines in the Territory.

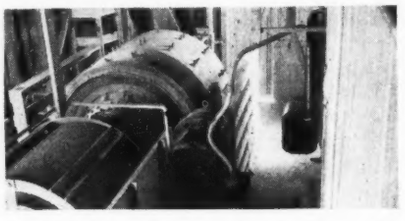
Manufacture of lighter steel mine cars was announced by Carnegie-Illinois Steel Corporation, Pittsburgh, Pa. Built of alloy steel, they are constructed 20 to 30 per cent lighter. The company also made a Carnegie-Illinois No. 2 clip for use with steel rails and steel mine ties. The International Nickel Company reports wider acceptance of nickel-copper alloy steels in mine cars. Considerations are being made for applications in construction of skips, cages, and chutes where ordinary carbon steels are now employed.

Edison Storage Battery Division, West Orange, N. J., reports many mine managements are seeking relief from the maximum penalty demand on electrical current, by using storage-battery locomotive for tramming purposes. Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., announced a new application of an automatic dynamic braking device, in event of power interruption on electric locomotion when tramming heavy loads down grade. Utility Mine Equipment Company, St. Louis, Mo., redesigned its entire line of aluminum rail benders, resulting in a strength increase said to be approximately 30 per cent, and reduced the weight of the units from one to seven pounds respectively.

Feeders—Seeking to give mill operators, and others interested, control of ore feed, manufacturers offered new and improved vibrating conveyors and feeders. For bypassing fines ahead of secondary crushers, Jeffrey Manufacturing Company, Columbus, Ohio, announced the Jeffrey-Traylor electric vibrating grizzly feeder. The grizzly section is built into the discharge end of the feeder, thereby avoiding mechanical moving parts. This unit is applicable for feeding to a belt that permits fines to drop through and form a cushion for large angular lumps. Another type unit by Jeffrey is the Jeffrey-Traylor "conveyangrizzly," which is used at the discharge of ore pockets to bypass fines ahead of secondary crushers. The Syntron Company, Homer City, Pa., brought out a vibrating feeder, Model F-32, for controlling the feed or flow of material in processing by simply turning a rheostat in the controller. Fraser & Chalmers Engineering Works, Erith, Kent, England, announced the Sherwen electromagnetic vibrating feeder-conveyor for light, medium and heavy-duty service in handling fine-crushed rock up to 15 in. size. The Utah Electric Vibrating Feeder and Conveyor of the Allis-Chalmers Manufacturing Company, announced late in 1936, went through the initial testing stage, and eighteen of these feeders are reported now scheduled for operation.

Jigs—Use of jigs on gold dredges continues to increase, and some manufacturers believe the advance in placer gold metallurgy during the year is due to greater willingness of operators to adopt already proved milling methods. The Pan American Engineering Company, Berkeley, Calif., introduced its balanced type placer jig and improved the pulsator of its jig during the year. The low, California type Bendelari jig for gold dredge applications was redesigned during the year. This type of jig is also recommended by F. M. Bendelari, Joplin, Mo., for use in closed circuit with a ball mill and classifier in gold mills so as to lower the feed launder.

Scrubbers—High metal prices during 1937 made many mine dumps profitable, but in some cases treatment problems were involved. Hardinge Company, York, Pa., announced its Conical Scrubber incorporated with a trommel screen, for removing clay and colloidal slimes from ores.



HARDINGE conical scrubber heads this trommel screen

Edgar Allen & Company, Ltd., Sheffield, England, placed on the market an imperial vibrating scrubber and washer, comprised of two horizontal steel troughs inclined slightly against the direction of rotation.

Screens—To reduce dust hazard in dry screening, the Universal Vibrating Screen Company, Racine, Wis., added to its line several new vibrating screens said to be dust-tight. The top and bottom inclosures are so constructed that operation is said to be as quiet as in the company's standard open types.

Featuring gasketed joints and sealed against leakage of vapors, liquids, or dust, the Productive Equipment Corporation, Chicago, offers its latest Selectro vibrating screen. The company's complete line of vibrating screens is so designed that the amount of eccentricity can be varied over a range of eight settings, giving to any material the particular intensity of vibration required to screen it most efficiently.

Filters—Recent installations of the Merrill-Crowe simultaneous clarification precipitation process embody the new development in clarifying cyanide solutions; namely, "precoating" of the clarifying leaves. Substantially complete elimination of deleterious substances such as colloidal slime, and precipitated hydrates of aluminum, iron, or magnesium, are said to now be obtained in cyanide solutions, resulting in cleaner precipitates, lower zinc consumption, and improved precipitation of the metals.

Dust Control Equipment—Interest in legislation by several states to cover dust control has aroused mine and industrial plant operators to seek methods and equipment that will reduce, and, if possible, bring the dust hazard to a minimum. Various types of dust collectors and air filters are now offered to the industry. More devices can be expected as research and investigation move onward, seeking a practical method to prevent silicosis.

In addition to its regular line of dust collectors, the Western Precipitation Corporation, Los Angeles, Calif., recently announced a specialized engineering service that determines the best type of dust-collecting system for the job investigated. The W. W. Sly Manufacturing Company, Cleveland, Ohio, announced a redesigned dust-collecting unit, particularly with reference to an improved mounting of filter bags and simplified shaking device.

Northern Blower Company, Cleveland Ohio, announced a new type, high-speed Norblo fan designed to meet the requirements of dust collection in the company's specially designed square type and round type automatic air filters for the collection of dust and fumes common to mines and smelters.

A small filter for ventilating purposes was brought out by the American Air Filter Company, Louisville, Ky. Known as the Unimatic, it is also used in filtering air for protection of engines and compressors and is available in capacities from 1,000 cu.ft. per minute to 30,000 cu.ft.

To fill the need for a simple and quick method of determining dust count, Bausch & Lomb Optical Company, Rochester, N. Y., announced its B. & L. dust counter.

Excavators—Bucyrus Erie Company, South Milwaukee, Wis., brought out a 1¼-cu.yd. excavator, convertible for shovel dragline, clamshell, crane, or drag-shovel service. The company also announced a new four-wheel scraper said to have ample clearance to swivel the front wheels under the frame, making a complete circle within the radius of its own length.

Harnischfeger Corporation, Milwaukee, Wis., announced a new, heavy-duty 1¼-cu.-yd. excavator recently. The new P & H Model 555

is said to be made of new alloy steel, all welded from crawler frames to dipper, and considerable weight has been removed.

Valves and Fittings—Walworth Company, New York, N. Y., presented a new line of bronze valves from ¼ to 2 in. The disk and seat are said to be made of high-chrome, non-corrosive stainless steel, heat-treated to a minimum Brinell hardness of 500. The company's new carbon molybdenum steel valves, Series 150 and 300, are said to have deep stuffing boxes designed to carry nine rings of packing. Merco-Nordstrom Valve Company, Pittsburgh, Pa., developed a round-opening lubricated plug valve during the year for use in the mining industry. S. R. Dresser Manufacturing Company, Bradford, Pa., announced a standard line of self-contained pipe joints that are said to make tight, flexible connections on plain end or threaded pipe. Their features are said to eliminate time for cutting pipe to exact lengths, threading, grooving, or screwing up joints.

Pumps—The Kimball Krogh Pump Division of Victor Equipment Company, San Francisco, Calif., designed a new, two-stage high-pressure pump for the mining industry, said to feature few replacement parts and having all rotating parts carried on the extended motor shaft, and a small hydraulic thrust.

International Combustion, Ltd., Aldwych House, London, England, announced a Vacseal pump having all wearing parts lined with a soft, abrasion-resisting rubber.

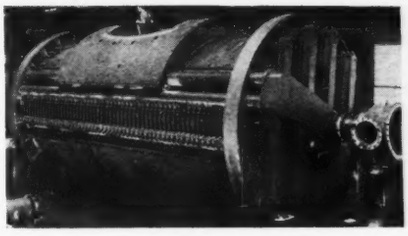
Barrett, Haentjens & Company, Hazleton, Pa., announced the Hazleton-Auto-Pump, combining in one unit a pump and a priming tank adaptable to full automatic control. The feature is said to be, that only part of the air used during priming period passes through the pump; the remainder is expelled from the priming tank directly into the discharge line.

Peerless Pump Division, Los Angeles, Calif., reports progressive steps of improvement in its line of pumps for the mining industry. The company is said to have standardized on certain metal alloys resistant to acid-bearing or corrosive water and has adopted the bypass seal, double seal, and suction manifold sand collar in its mine pump for efficiency in pumping sandy water.

For general dredging service, Morris Machine Works, Baldwinsville, N. Y., brought out two new lines of materials-handling pumps. Type F is said to have the feature of balancing the pressure around the suction shroud of the pump, thereby preventing circulation of material at this point. The line of double-suction dewatering pumps has been revised to feature the company's floating type of sealing ring.

A rotor and stator valveless pump was announced by Robbins & Meyer, Springfield, Ohio, known as the Moyno pump. Its pumping elements consist of one stationary part called the stator and one rotating part, the rotor assembly. The stator is in the form of a cylindrical lining which has an internal form of double-threaded helix. The pump is positive in displacement, and is said to have no suction or discharge valves to lift, and is self-priming to within 1½-in. mercury gage of varometer.

Lighting—An improvement announced by the Koehler Manufacturing Company, Marlboro, Mass., in its line of Wheat miners' electric cap lamps was the adoption of a new, concentrated beam reflector.



Improved Peirce-Smith copper converter manufactured by Allis-Chalmers

Classifiers—Dorr Company, New York City, N. Y., introduced a new classifier to provide better all-round classification at all separations up to and including 80 mesh. The feature of the units is the utilization for the first time of a combination of turbulence, high pulp velocity, and quiescent overflow to obtain a cleaner sand product and a more readily controlled overflow. To meet the requirements of gold and silver cyanide mills where practice requires agitation of pulp between first or pregnant solution thickener, and the counter-current decantation series, the Dorr combination type washing tray thickener was introduced.

Crushing and Grinding—Refinement of control in the lubrication system of its gyratory crushers was announced by Kennedy-Van Saun Manufacturing & Engineering Corporation, New York City, N. Y. The company's ball-bearing gearless crushers can be fitted with automatic oil-pressure switch controls that will either sound a horn, operate signal lights, or shut down the motor driving the crusher, should oil pressure in the lubricating system be above or below a predetermined oil-pressure range. During the last six months Denver Equipment Company, Denver, Colo., reported an expansion of its line of ball mills to include units 5 ft. in diameter. To eliminate oil and grease pollution from ball and rod mills in flotation process, Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., has developed the Micarta bearing using water as a lubricant. Straub Manufacturing, Inc., Oakland, Calif., announced the manufacture of special grinding mills for chain drive and mills for use where sliming is not desirable. Southwestern Engineering Company, Los Angeles, Calif., brought out a new electrically operated sampler said to assure precision in dry ore and pulp stream sampling.

Hoists—A new unit assembly of two- and three-drum hoists was announced by Ingersoll-Rand in 1937. Each unit is self-contained and consists of barrel-type housing, drum, gearing, and clutch. Two or three units are assembled together to make a two-drum or three-drum slusher hoist. These units are electrically operated. Hoists applicable to scraping and other operations underground were announced by Gardner-Denver. They are powered by a five-cylinder radial air motor of compact design and are said to have smaller over-all dimensions and less weight per horsepower developed than any other machine of this type. Construction of electrical equipment for the largest and one of the fastest a.-c. mine hoists in America was announced by the General Electric Company, Schenectady, N. Y., for installation by the Tennessee Coal, Iron & Railway Company. A 25-ton unbalanced load will be hoisted 3,600 ft. per minute. (Fastest hoisting speed in U. S. is about 4,000 ft. per minute.)

Sullivan Machinery Company, Claremont, N. H., announced a new line of two- and three-drum scraper haulers and added six new models to its line of three-drum scraper haulers. A new line of double-drum portable shaft hoists and new prospector's portable single-drum hoists were also brought out.

Safety First—New products and devices to protect life and limb of the worker in mine, mill, or smelter are always welcome by the operator. During 1937, C. D. Bullard Company, San Francisco, Calif., perfected its Tuff-Nut safety hat. It is made of one piece of heavy fibre, is well reinforced, adjustable, and is said to be extremely light.

Mine Safety Appliances Company, Pittsburgh, announced the 3-oz. McDonald Dustfoe respirator for protection against harmful dusts. A duralumin McDonald safety hat was also brought out in two models which are said to have maximum lightness and strength. A one-hour self-contained oxygen breathing apparatus approved by the Bureau of Mines, working on the lung-controlled principle, was also announced by the company. For eye protection the American Optical Company added the Ful-Vue goggle with wire-mesh shields, and the Duralite Coverglass goggle, an improved lighter-weight type for welders who continually wear glasses.

Summary of the

MARKETS

BUSINESS in major non-ferrous metals improved moderately during January, though inquiry was mostly for forward material. Continued uncertainty over the Administration's program, particularly toward the end of the month, made for further unsettlement in copper prices. The *E. & M. J.* index of prices for January was 75.56, which compares with 75.18 in December and 87.03 in January last year.

Domestic copper fell back to 10c., Valley, toward the close, with both the mine group and custom smelters quoting at that level. Not much business was booked on the decline, but, on the other hand, there was virtually no selling pressure. Stocks of copper are still increasing, which tends to discourage buying. Domestic bookings for January total 25,543 tons, against 26,504 tons in December. Domestic deliveries during December dropped sharply to 18,103 tons, though actual domestic consumption was estimated at 32,000 tons for the closing month of 1937. The export quotation showed little net change for January. Sentiment abroad was strongly influenced by the news from this country.

The first two weeks of January witnessed some active buying of lead and moderately higher prices. The activity subsided in the second half of the month, yet quotations were easily maintained on the 4.90c. New York basis.

Imports of slab zinc during December totaled 1,743 tons, bringing the total for the year to 39,398 tons. Imports in 1936 totaled 11,722 tons. The market here was quiet, but prices appeared steady on the basis of 5c., St. Louis, for Prime Western.

Owing to the advance in the freight rate of $1 per long ton, effective Jan. 1, 1938, our differential between the c.i.f. European ports basis and the f.o.b. refinery quotation on export copper has been revised to 0.350c.

UNITED STATES MARKET

1938	Electrolytic Copper		Straits Tin	Lead		Zinc
Jan.	Domestic (a)	Export (b)	New York	New York	St. Louis	St. Louis
1	Holiday	Holiday	Holiday	Holiday	Holiday	Holiday
3	9.900	9.475	41.125	4.75	4.60	5.00
4	9.900	9.525	41.625	4.75	4.60	5.00
5	10.025	9.700	42.000	4.75	4.60	5.00
6	10.025	9.850	41.750	4.75	4.60	5.00
7	10.275	9.975	42.000	4.85	4.70	5.00
8	10.275	10.050	42.000	4.85	4.70	5.00
10	10.400	10.150	42.125	4.85	4.70	5.00
11	10.650	10.250	42.875	4.90	4.75	5.00
12	10.650	10.450	43.000	4.90	4.75	5.00
13	10.650	10.300	42.200	4.90	4.75	5.00
14	10.650	10.150	41.750	4.90	4.75	5.00
15	10.650	10.150	42.625	4.90	4.75	5.00
17	10.525 @ 10.650	10.300	42.500	4.90	4.75	5.00
18	10.525	10.400	41.625	4.90	4.75	5.00
19	10.275	10.175	41.500	4.90	4.75	5.00
20	10.025	10.050	41.625	4.90	4.75	5.00
21	10.025	9.850	41.375	4.90	4.75	5.00
22	10.025	9.825	41.125	4.90	4.75	5.00
24	10.025	9.625	40.875	4.90	4.75	5.00
25	10.025	9.600	40.875	4.90	4.75	5.00
26	10.025	9.600	40.625	4.90	4.75	5.00
27	10.025	9.600	40.500	4.90	4.75	5.00
28	9.775	9.550	40.250	4.90	4.75	5.00
29	9.775	9.600	40.000	4.90	4.75	5.00
31	9.775	9.500	40.750	4.90	4.75	5.00
Average For month	10.198	9.908	41.548	4.870	4.720	5.000
			AVERAGES FOR WEEK			
Jan.						
5	9.925	9.525	41.400	4.75	4.60	5.000
12	10.379	10.121	42.292	4.85	4.70	5.000
19	10.556	10.246	42.033	4.90	4.75	5.000
26	10.025	9.758	41.083	4.90	4.75	5.000
			CALENDAR WEEK AVERAGES			
Jan.						
1	9.900	9.495	41.275	4.750	4.600	5.000
8	10.067	9.763	41.750	4.783	4.633	5.000
15	10.608	10.242	42.429	4.892	4.742	5.000
22	10.244	10.100	41.625	4.900	4.750	5.000
29	9.942	9.596	40.521	4.900	4.750	5.000

SILVER, GOLD, AND STERLING EXCHANGE

NEW YORK AND LONDON

1938	Sterling Exchange		Silver		Gold	
Jan.	"Checks"	"90-day demand"	(c) New York	London	London	(d) United States
1	Holiday	Holiday	Holiday	Holiday	Holiday	Holiday
3	5.00375	4.99625	44.750	19.2500	139s 5d	$35.00
4	5.00375	4.99625	44.750	19.5625	139s 6d	35.00
5	5.00000	4.99250	44.750	19.5625	139s 9d	35.00
6	4.99625	4.98875	44.750	19.4375	139s 8½d	35.00
7	4.99875	4.99125	44.750	19.6250	139s 9d	35.00
8	5.00125	4.99375	(e)	19.6875	139s 9½d	35.00
10	5.00125	4.99375	44.750	19.5625	139s 9d	35.00
11	5.00000	4.99250	44.750	19.8125	139s 8d	35.00
12	4.99625	4.98875	44.750	19.9375	139s 7½d	35.00
13	4.99625	4.98875	44.750	19.8750	139s 7d	35.00
14	4.98875	4.98125	44.750	19.8125	139s 7½d	35.00
15	4.99500	4.98750	(e)	19.7500	139s 7½d	35.00
17	4.99500	4.98750	44.750	19.9375	139s 8½d	35.00
18	4.99625	4.98875	44.750	20.0625	139s 7½d	35.00
19	4.99750	4.99000	44.750	20.3750	139s 7½d	35.00
20	4.99750	4.99000	44.750	20.1875	139s 7½d	35.00
21	4.99750	4.99000	44.750	20.0000	139s 8d	35.00
22	4.99750	4.99000	(e)	20.0000	139s 7½d	35.00
24	4.99625	4.98875	44.750	20.0000	139s 7½d	35.00
25	4.99500	4.98625	44.750	20.0000	139s 7d	35.00
26	4.99750	4.99000	44.750	20.1250	139s 7½d	35.00
27	5.00125	4.99375	44.750	20.2500	139s 6d	35.00
28	5.00250	4.99500	44.750	20.1250	139s 6½d	35.00
29	5.00625	4.99875	(e)	20.2500	139s 7d	35.00
31	5.01250	5.00500	44.750	20.1875	139s 6d	35.00
Average for Mo.	4.99895	.....	44.750	19.895	.....	35.00
			AVERAGES FOR WEEK			
Jan.						
5	4.99950	.....	44.750	.....	.....	.....
12	4.99896	.....	44.750	.....	.....	.....
19	4.99479	.....	44.750	.....	.....	.....
26	4.99688	.....	44.750	.....	.....	.....

Calendar week averages: New York Silver, Jan. 1st, 44.750; 8th, 44.750; 15th, 44.750; 22nd, 44.750; 29th, 44.750.

(e) Not quoted; Saturday.

THE above quotations for major non-ferrous metals are our appraisal of the important United States markets, based on sales reported by producers and agencies. They are reduced to the basis of cash, New York or St. Louis, as noted. All prices are in cents per pound.

(a) Net prices at refineries on Atlantic seaboard. To arrive at the delivered New England basis, add 0.225c. per pound, the average differential for freight and delivery charges.

(b) Export prices are net at refineries on the Atlantic seaboard and include sales of domestic copper in the foreign market. Most sales in the foreign market are made on the basis of c.i.f. usual ports of destination—Hamburg, Havre, and Liverpool. The c.i.f. basis commands a premium of 0.350c. per pound above our refinery quotation.

Copper, lead and zinc quotations are based on sales for both prompt and future deliveries; tin quotations are for prompt delivery only.

Quotations for copper are for the ordinary forms of wirebars and ingot bars; cathodes are sold at a discount of 0.125c.

Quotations for zinc are for ordinary Prime Western brands. Zinc in New York commands a premium over the St. Louis basis equal to the freight differential. Contract prices for High Grade zinc delivered in the East and Middle West in nearly all instances command a premium of 1c. per pound over the current market for Prime Western but not less than 1c. over the *E. & M. J.* average for Prime Western for the previous month.

Quotations for lead reflect prices obtained for common lead, and do not include grades on which a premium is asked.

(c) Silver other than newly mined domestic. Under Executive order effective Jan. 1, 1938, the U. S. Government's price on newly mined domestic silver was established at 64.64c. Handy & Harman's quotation for domestic silver, .999 fine, was 64⅛c. per ounce throughout January.

(d) U. S. Treasury's gold price. Actual payment by the United States Treasury for gold in domestic and imported ore or concentrate is at 99.75 per cent of the price quoted by the Treasury, which at present is equal to $34.9125 per ounce.

PRICES OF METALS • MISCELLANEOUS QUOTATIONS

LONDON MARKET

1938 Jan.	COPPER Standard Spot	COPPER Standard 3 months	COPPER Electro Bid	TIN Standard Spot	TIN Standard 3 months	LEAD Spot Buyers	LEAD Spot Sellers	LEAD 3 months Buyers	LEAD 3 months Sellers	ZINC Spot Buyers	ZINC Spot Sellers	ZINC 3 months Buyers	ZINC 3 months Sellers
3	39.4375	39.6250	43.2500	181.2500	181.2500	15.1250	15.2500	15.3125	15.3750	14.5000	14.5625	14.7500	14.8125
4	39.7500	39.9375	43.5000	181.7500	181.5000	15.1875	15.3125	15.3750	15.4375	14.6250	14.6875	14.8125	14.8750
5	40.9375	41.1875	45.2500	186.5000	186.2500	15.7500	15.8125	15.8750	16.0000	14.9375	15.0000	15.1875	15.2500
6	40.8125	41.0000	45.0000	184.0000	183.7500	15.9375	16.0000	16.0625	16.1250	14.7500	14.8125	15.0000	15.0625
7	41.6250	41.8125	46.0000	186.2500	186.0000	16.1875	16.2500	16.3750	16.4375	15.0625	15.1250	15.3125	15.3750
10	42.6250	42.8125	46.7500	185.7500	185.5000	16.5000	16.5625	16.6875	16.7500	15.3125	15.3750	15.5625	15.6250
11	44.1875	44.3750	48.0000	188.5000	188.5000	16.9375	17.0000	17.1875	17.2500	15.7500	15.8750	15.9375	16.0625
12	44.1250	44.3125	48.3750	191.0000	190.6250	17.5625	17.6875	17.7500	17.8125	15.8750	15.9375	16.0625	16.1250
13	43.4375	43.5625	47.5000	187.3750	187.6250	17.3750	17.4375	17.5625	17.6250	15.5000	15.6250	15.7500	15.8125
14	42.5000	42.7500	46.2500	185.0000	185.2500	17.0000	17.1250	17.1875	17.3125	15.4375	15.5625	15.6250	15.6875
17	43.8750	44.0000	47.7500	188.5000	188.7500	16.9375	17.0000	17.0000	17.0625	15.5000	15.5625	15.6250	15.6875
18	43.2500	43.5000	47.5000	185.5000	186.0000	16.8125	16.8750	16.8750	16.9375	15.3750	15.5000	15.5625	15.6250
19	42.3125	42.5625	46.5000	184.2500	185.0000	16.0625	16.1250	16.1875	16.2500	15.0625	15.1250	15.2500	15.3125
20	41.6250	41.8125	45.5000	182.2500	183.2500	15.8125	15.8750	15.8750	15.9375	14.6250	14.7500	14.8750	14.9375
21	41.0625	41.2500	44.7500	182.2500	183.2500	15.4375	15.5625	15.5000	15.5625	14.4375	14.5000	14.6250	14.6875
24	40.0625	40.3125	43.7500	180.7500	181.7500	15.5625	15.6250	15.6250	15.6875	14.4375	14.5625	14.5625	14.6250
25	39.7500	40.0000	43.5000	180.5000	181.2500	15.5625	15.6250	15.6875	15.7500	14.5000	14.5625	14.6875	14.7500
26	40.1875	40.3750	44.0000	181.0000	182.0000	15.6875	15.7500	15.8125	15.8750	14.6875	14.7500	14.9375	15.0000
27	39.4375	39.6875	43.5000	178.8750	179.5000	15.5000	15.6250	15.5625	15.6250	14.5625	14.6250	14.6250	14.6875
28	39.2500	39.5000	43.5000	177.0000	177.5000	15.4375	15.5625	15.5000	15.6250	14.5000	14.6250	14.6250	14.6875
31	38.8750	39.1250	43.0000	177.7500	178.5000	15.5625	15.6875	15.5625	15.6250	14.5625	14.6250	14.5625	14.6250
Average for month	41.387	.....	45.387	183.619	.....	16.135		16.253		14.994		15.173	

Prices for lead and zinc are the official prices for the first session of the London Metal Exchange; prices for copper and tin are the official closing buyers' prices. All are in pounds sterling per long ton of 2,240 lb.

CURRENT PRICES — MISCELLANEOUS METALS, ORES, AND NON-METALLIC MINERALS

Quotations cover wholesale lots, prompt shipment, f.o.b. New York, unless otherwise stated
(February 1, 1938)

MISCELLANEOUS METALS

Aluminum, ingot, 99 plus per cent, lb	20c.
Antimony, domestic, spot, lb	13.750c.
Bismuth, ton lots, lb	$1.00
Cadmium, lb	$1.00 @$1.35
Calcium, lb., ton lots 98 @ 99 per cent	75c.
Chromium, 97 per cent grade, lb	85c.
Nickel, electrolytic cathodes, lb	35c.
Magnesium, 99.8 per cent, carloads, lb	30c.
Palladium, troy oz	$24.00
Platinum, (Official quotation) troy oz	$36.00
Quicksilver, flask of 76 lb., 100 flasks or more	$79@$80
Radium, mg. radium content	$40.00
Selenium, 99.5 per cent, lb	$2.00
Silicon, minimum 97 per cent, spot, lb	16.50c.
Tellurium, lb	$1.75@$2.00
Thallium, 100 lb. or more, lb	$6.50
Titanium, 96 to 98 per cent, lb	$6.00
Zirconium, commercially pure, lb	$7.00

METALLIC ORES

Beryllium Ore, f.o.b. mines, ton	$30.00@$35.00
Chrome Ore, 48 @ 50 per cent, c.i.f. Atl. ports, long ton	$24.00@$26.00
Iron Ore, Lake Superior, Lower Lake ports, long ton:	
Old Range bessemer	$5.25
Mesabi bessemer	$5.10
Old Range non-bessemer	$5.10
Mesabi, non-bessemer	$4.95
Lead (Galena) 80 per cent Joplin, Mo., ton	$55.09
Manganese Ore, c.i.f. Atlantic ports, long ton unit:	
52 @ 55 per cent	45c.
50 @ 52 per cent	45c.
44 @ 48 per cent	40c.
Molybdenum Ore, 90 per cent, per lb. of contained MoS_2	42c.
Tungsten Ore, per unit of WO_3:	
Chinese duty paid	$23.50
Domestic Scheelite	a$22.00@$25.00
Vanadium Ore, per lb. of contained V_2O_5	27½c.
Zinc, Ore, Prime, 60 per cent concentrate, Joplin, Mo.; per ton.	$32.00

(a) Nominal.

METALLIC COMPOUNDS

Arsenious Oxide (arsenic) lb	3c
Cobalt Oxide, 70 @ 71 per cent, lb	$1.67@$1.77
Copper Sulphate, 100 lb	$4.25
Sodium Nitrate, ex vessel, in 200-lb. bags, per 100 lb	$1.34
Sodium Sulphate, bulk, ton	$13.00@$15.00

ALLOYS

Beryllium Copper, Master alloy, 2.5 to 3 per cent Be, per lb. of contained Be	$23.00
Ferrochrome, 65 @ 70 per cent chromium, 4 @ 6 per cent carbon, lb	10½c.
Ferromanganese, 78 @ 82 per cent, gross ton	$102.50
Ferromolybdenum, 50 @ 60 per cent Mo, lb. of Mo contained	95c.
Ferrosilicon, 50 per cent, gross ton	$69.50
Ferrotungsten, 75 @ 80 per cent, lb. of W contained	$2.00

NON-METALLIC MINERALS

Asbestos, f.o.b. mines ton:	
Canadian (Quebec)	
Crude No. 1	$700@$750
Crude No. 2	$150@$350
Spinning fibers	$110@$200
Paper stock	$40@$45
Shorts	$12@$16.50
Vermont	
Shingle stock	$57
Paper stock	$40
Cement stock	$25
Barytes, long ton:	
Georgia, crude	$7.00
Missouri, 90 per cent $BaSO_4$, less than 1 per cent iron	$6.00@$7.00
Bauxite, long ton:	
Domestic, chemical, 55 @ 58 per cent	$6.50@$7.50
Domestic, abrasive, 70 @ 84 per cent	$12.50@$15.00
Dalmatian, 50 @ 55 per cent	(a)$6.50@$7.50
French, 56 @ 59 per cent	(a)$8.00@ 9.00
China Clay, f.o.b. mines, ton:	
South Carolina and Georgia, No. 1, bulk	$6.75@$8.00
Delaware, No. 1	$14.50@.....
Feldspar, bulk, ton:	
Potash feldspar, 200 mesh	$17.00
Glass-spar, white, 20 mesh	$11.75
Fluorspar, f.o.b. mines, bulk, Kentucky and Illinois 85-5 per cent, all rail movement, ton	$20.00
Fuller's earth, f.o.b. Georgia or Florida, ton	$7.00@$14.00
Magnesite, per ton:	
Dead-burned, f.o.b. California	$25.00@.....
Dead-burned, f.o.b. Washington	$25.00@.....
Mica, per lb., North Carolina, No. 1 and 2 quality:	
1½ x 2 in.	15@40c.
2 x 2 in.	30@60c.
3 x 3 in.	75@$1.20
3 x 4 in.	$1.00@$1.40
4 x 6 in.	$2.00@$2.50
White, ground, 70 mesh, ton	$60.00@$80.00
Ocher, Georgia, ton	$19.00@$22.00
Pyrites, Spanish, per long ton unit of S, c.i.f. Atlantic ports	(a) 12@12½c
Silica, water-floated, in bags, 325 mesh, ton	$16.00@$40.00
Sulphur, Texas mines, long ton	$18.00@.....
Talc, f.o.b. works, ton:	
New York, double air-floated, 325 mesh	$12.00@$15.00
New Jersey, mineral pulp	$8.00@$10.00
Vermont, extra white, 200 mesh	$9.00@ $9.50
Tripoli, Missouri, ton:	
40 mesh, cream colored	$15.00@.....
200 mesh, cream colored	$25.00@.....

(a) Nominal.

IRON AND STEEL

Pig Iron, Valley furnaces, gross ton:	
Bessemer	$24.50
Basic	$23.50
No. 2 Foundry	$24.00
Steel, base prices, Pittsburgh:	
Billets, gross ton	$37.00
Structural shapes, 100 lb	$2.25
Bars, 100 lb	$2.45

Monthly and Yearly

AVERAGE PRICES

SILVER AND STERLING EXCHANGE

	New York		London Spot		Sterling Exchange	
	1937	1938	1937	1938	1937	1938
January	44.913	44.750	20.734	19.895	490.670	499.895
February	44.750	.....	20.083	.....	489.307	.....
March	45.130	.....	20.677	.....	488.412	.....
April	45.460	.....	20.740	.....	491.524	.....
May	45.025	.....	20.346	.....	493.835	.....
June	44.818	.....	20.022	.....	493.404	.....
July	44.750	.....	19.986	.....	496.582	.....
August	44.750	.....	19.848	.....	498.043	.....
September	44.750	.....	19.889	.....	495.145	.....
October	44.750	.....	19.942	.....	495.395	.....
November	44.750	.....	19.707	.....	499.467	.....
December	44.750	.....	18.835	.....	499.510	.....
Year	44.883	.....	20.067	.....	494.275	.....

New York quotations for silver not eligible for sale to U. S. Government, cents per ounce troy, 999 fine. London, pence per ounce sterling silver 925 fine. Sterling exchange in cents.

COPPER

	F.O.B. Refinery, Electrolytic				London Spot			
	Domestic		Export		Standard		Electrolytic (a)	
	1937	1938	1937	1938	1937	1938	1937	1938
January	12.415	10.198	12.112	9.908	51.497	41.387	56.288	45.387
February	13.427	.....	13.828	.....	59.225	.....	64.013	.....
March	15.775	.....	16.590	.....	72.339	.....	76.167	.....
April	15.121	.....	14.692	.....	62.506	.....	66.614	.....
May	13.775	.....	13.999	.....	61.118	.....	63.684	.....
June	13.775	.....	13.492	.....	55.696	.....	61.409	.....
July	13.775	.....	13.817	.....	56.412	.....	62.807	.....
August	13.775	.....	13.926	.....	57.143	.....	63.595	.....
September	13.530	.....	12.984	.....	52.989	.....	58.966	.....
October	11.838	.....	11.207	.....	45.384	.....	50.619	.....
November	10.797	.....	9.850	.....	39.321	.....	44.023	.....
December	10.006	.....	9.714	.....	39.946	.....	43.886	.....
Year	13.167	.....	13.018	.....	54.465	.....	59.339	.....

New York quotations, cents per pound. London, pounds sterling per long ton, (a) Bid quotation.

LEAD

	New York		St. Louis		London			
	1937	1938	1937	1938	1937 Spot	1937 3 Mos.	1938 Spot	1938 3 Mos.
January	6.000	4.870	5.850	4.720	27.272	27.150	16.135	16.253
February	6.239	.....	6.089	.....	28.319	28.328	.....	.....
March	7.190	.....	7.040	.....	33.027	32.979	.....	.....
April	6.175	.....	6.025	.....	26.014	25.878	.....	.....
May	6.000	.....	5.850	.....	24.000	23.891	.....	.....
June	6.000	.....	5.850	.....	22.878	22.759	.....	.....
July	6.000	.....	5.850	.....	23.932	23.703	.....	.....
August	6.452	.....	6.302	.....	22.606	22.670	.....	.....
September	6.400	.....	6.250	.....	20.990	21.044	.....	.....
October	5.740	.....	5.590	.....	18.259	18.318	.....	.....
November	5.033	.....	4.883	.....	16.706	16.714	.....	.....
December	4.875	.....	4.725	.....	15.905	15.994	.....	.....
Year	6.009	.....	5.859	.....	23.326	23.286	.....	.....

New York and St. Louis quotations, cents per pound. London pounds sterling per long ton.

TIN

	Straits New York		Standard, Spot London	
	1937	1938	1937	1938
January	50.925	41.548	229.350	183.619
February	52.010	.....	233.750	.....
March	63.043	.....	282.988	.....
April	59.172	.....	267.136	.....
May	55.651	.....	250.645	.....
June	55.851	.....	249.852	.....
July	59.245	.....	263.540	.....
August	59.465	.....	264.595	.....
September	58.675	.....	258.943	.....
October	51.654	.....	223.869	.....
November	43.299	.....	190.477	.....
December	43.051	.....	190.449	.....
Year	54.337	.....	242.133	.....

New York quotations cents per pound. London, pounds sterling per long ton.

ZINC

	St. Louis		London			
	1937	1938	1937 Spot	1937 3 Mos.	1938 Spot	1938 3 Mos.
January	5.847	5.000	21.153	21.281	14.994	15.173
February	6.465	.....	25.122	25.322	.....	.....
March	7.381	.....	33.188	33.405	.....	.....
April	7.010	.....	26.216	26.344	.....	.....
May	6.750	.....	23.092	23.365	.....	.....
June	6.750	.....	21.409	21.528	.....	.....
July	6.923	.....	22.568	22.693	.....	.....
August	7.192	.....	24.140	24.290	.....	.....
September	7.190	.....	21.406	21.607	.....	.....
October	6.085	.....	17.722	17.955	.....	.....
November	5.630	.....	15.808	15.970	.....	.....
December	5.010	.....	15.274	15.429	.....	.....
Year	6.519	.....	22.258	22.432	.....	.....

St. Louis quotations, cents per pound. London, pounds sterling per long ton

CADMIUM AND ALUMINUM

	Cadmium		Aluminum	
	1937	1938	1937	1938
January	90.000	117.500	19.500	20.000
February	90.000	.....	19.500	.....
March	101.667	.....	20.000	.....
April	105.000	.....	20.000	.....
May	105.000	.....	20.000	.....
June	130.962	.....	20.000	.....
July	142.500	.....	20.000	.....
August	142.500	.....	20.000	.....
September	142.500	.....	20.000	.....
October	142.500	.....	20.000	.....
November	142.500	.....	20.000	.....
December	132.888	.....	20.000	.....
Year	122.335	.....	19.917	.....

Aluminum in cents per pound, 99 per cent grade. Cadmium, cents per pound.

ANTIMONY, QUICKSILVER, AND PLATINUM

	Antimony (a) New York		Quicksilver (b) New York		Platinum (c) New York	
	1937	1938	1937	1938	1937	1938
January	14.130	13.750	90.250	79.240	50.400	36.000
February	14.563	.....	91.000	.....	64.364	.....
March	16.375	.....	91.778	.....	58.000	.....
April	16.043	.....	92.000	.....	58.000	.....
May	14.830	.....	95.520	.....	54.800	.....
June	14.702	.....	96.654	.....	53.000	.....
July	14.803	.....	93.904	.....	50.115	.....
August	15.327	.....	91.423	.....	51.000	.....
September	16.555	.....	89.020	.....	51.000	.....
October	16.935	.....	86.140	.....	48.560	.....
November	15.848	.....	83.435	.....	43.652	.....
December	14.144	.....	81.038	.....	38.385	.....
Year	15.355	.....	90.180	.....	51.773	.....

(a) Antimony quotations in cents per pound, for ordinary brands. (b) Quicksilver in dollars per flask of 76 lb. (c) Platinum in dollars per ounce troy.

PIG IRON

	Bessemer		Basic		No. 2 Foundry	
	1937	1938	1937	1938	1937	1938
January	21.50	24.50	20.50	23.50	21.00	24.00
February	21.50	.....	20.50	.....	21.00	.....
March	24.20	.....	23.20	.....	23.70	.....
April	24.50	.....	23.50	.....	24.00	.....
May	24.50	.....	23.50	.....	24.00	.....
June	24.50	.....	23.50	.....	24.00	.....
July	24.50	.....	23.50	.....	24.00	.....
August	24.50	.....	23.50	.....	24.00	.....
September	24.50	.....	23.50	.....	24.00	.....
October	24.50	.....	23.50	.....	24.00	.....
November	24.50	.....	23.50	.....	24.00	.....
December	24.50	.....	23.50	.....	24.00	.....
Year	23.975	.....	22.975	.....	23.475	.....

Iron in dollars per long ton. F. o. b. Mahoning and Shenango Valley furnaces.

PERSONAL ITEMS

Henry C. Carlisle, consulting engineer, has returned to his headquarters in San Francisco from a trip to Mexico.

E. M. Lindenau has returned to the United States from Bolivia and can be reached at University Station, Tucson, Ariz.

G. S. Dyer has resigned as general manager of Marvel Loch Gold Development, Marvel Loch, W. A., and has been succeeded temporarily by **M. T. Dunstan.**

L. K. Jacobsen, mill superintendent of Mount Isa Mines, Ltd., Queensland, returned recently from a visit to America.

H. A. Steane has resigned as research metallurgist at Mount Isa Mines and is returning to Cyprus Mines Corporation as assistant mill superintendent.

C. E. Gregory has joined the mining staff of New Guinea Goldfields, Ltd. He was formerly mine superintendent for Central Norseman Gold Corporation Norseman, W. A.

Frank Jenkin, formerly connected with Cia. Minera el Pedregal y Anexas, Taxco, Guerrero, as mine superintendent, is now general manager of Cia. Minera de Teojomulco, S. A., at Sola de Vega, Oaxaca, Mexico.

O. E. Young is now employed as plant metallurgist at the Climax Molybdenum Company at Climax, Colo.

W. L. Anderson, formerly of Howe, Idaho, plans to assume charge of the Ermont Mines Company cyanide plant at Dillon, Mont.

Dr. Gerald M. Cover has been appointed assistant professor of metallurgy at the Case School of Applied Science, Cleveland, Ohio.

Arthur Swanson has left Mexico and is now superintendent of the Zeibright mine of the Empire Star Mines Company, Ltd., at Emigrant Gap. Calif.

A. L. Slaughter, formerly engineer with the Bald Mountain Mining Company at Trojan, S. D., has joined the geological staff of the Homestake Mining Company at Lead, S. D.

A. W. Holloway has left the position of mill superintendent for Minto Gold Mines, Ltd., and is now residing at 2525 West 13 Ave., Vancouver, B. C., Canada.

David R. Mitchell has been appointed professor and head of department of mining engineering at Pennsylvania State College. Professor Mitchell succeeds **W. R. Chedsey.**

John A. Burgess, formerly general superintendent of the Carson Hill operations of Carson Hill Gold Mining Corporation, Melones, Calif., has been appointed general manager.

Aguste Nopper is the new general manager of the Cia. Minera del Boleo, S. A., a French enterprise operating copper mines in the Santa Rosalia sector, Lower California.

C. Carleton Semple, because of illness in the family, has resigned as general superintendent of San Luis Gold Mines Company, Jaqui, Peru, and has returned to New York.

George L. H. Loram, consulting geologist and mining engineer, has returned to Berkeley, Calif., after a protracted professional stay in the Philippine Islands.

H. C. Henrie has been appointed general superintendent of the Copper Queen branch, mines division, of Phelps Dodge Corporation, succeeding I. H. Barkdoll, who died recently. Henrie has been assistant general superintendent.

R. L. Kidd, assistant professor of ore dressing at the University of Utah, has been chosen as the grand vice-president of the Western province of Sigma Gamma Epsilon, national mining, geology, and metallurgical fraternity.

Arthur W. Burgren, mining engineer, who for many years was employed as superintendent of various large mining properties in Mexico, has returned to California, where his address is Post Office Box 53, Mount Eden, Alameda County, Calif.

Robert D. MacAfee, Jr., formerly engineer in charge of field examination work in Idaho and Montana for Colonel O. B. Perry and Irving W. Bonbright interests, is now with the Day organization as metallurgist for the custom mill of the Hercules Mining Company at Wallace, Idaho.

Henry H. Moore, of Hallgarten & Company, has become a director of the Anaconda Copper Mining Company and its subsidiary, the Chile Copper Company. His selection fills the vacancies caused by the death of **Andrew J. Miller.**

Richard W. Unger, upon completion of a tailings re-treatment project near Winnemucca, Nev., accepted a position as mill superintendent for Le Roi Mines, Inc., at Jackson, Calif., to reopen a 100-ton flotation plant. Prior to reorganization, Le Roy was known as the Lucky Joe Mining Company.

Marshall S. Walker, of Walker & Whyte, Inc., assayers, who was appointed by President Hoover on the Annual Assay Commission in 1930, was so honored by President Roosevelt for 1938. The meeting was held at the Mint at Philadelphia on Feb. 9, 1938.

J. L. Bruce, resident director in Cyprus for Cyprus Mines Corporation and general manager of the Corporation, will be at its headquarters, 1206 Pacific Mutual Building, Los Angeles, Calif., until about April first, after which date he will return to the property at Cyprus.

L. Slessinger, who has been with the Santa Barbara unit of A. S. & R., at Santa Barbara, Chihuahua, Mexico, for the past seventeen years, has just returned to the United States from a visit with his son, **Louis E. Slessinger,** at Cristo, Cuba. Mr. Slessinger junior is a mill shift foreman with the Cuban Mining Company.

Frank A. Forward, instructor in the department of metallurgy at the University of British Columbia, has returned to Vancouver from Japan, where for several months he was engaged in research into the possibilities of refining there concentrate from the B. C. Nickel Mines, Ltd., property, situated near Choate, B. C.

A. A. Wren is now mine superintendent at the Getchell mine, 26 miles north of Golconda, Nev. A 600-ton cyanide plant is nearing completion. **Fred Wise** is general superintendent and **Carl Wark** is in charge of milling operations. Mining is to be by both surface benching and underground stoping.

Ivan E. Goodner, consulting engineer of Washington, D. C., and manager of several mining properties in New Mexico and Colorado, has moved his office to 403 Cooper Building, Denver, Colo. Mr. Goodner recently completed the Pioneer custom mill at Durango, Colo., and is planning to enlarge the operations of the Hiltscher placers near Hillsboro, N. M.

C. H. Carmichael, formerly manager of the Smartsville (Calif.) operation for the Tintic Standard Company, is now with the Day interests at Wallace, Idaho, and will be general superintendent of the Tamarack & Custer Consolidated Mining Company, Dayrock Mining Company, and Sherman Lead Company.

S. E. Stein directs attention to the fact that the item on page 57 of our issue for November, 1936, concerning the erection of its first mill by the Southwestern Engineering Company of P. I., credited the company with having completed the mill in "3½ months." The time should have been stated as 5½ months. The opportunity to make correction is appreciated.

R. S. Eskridge, of Seattle, Wash., has been retained by the Department

New 6 cu.ft. gold placer dredge of Yreka Gold Dredging Company operating near Yreka, Calif.

CALIFORNIA

New Mills Will Add To 1938 Gold Output

Several plants now under construction—Development at Moro Bay copper mine discloses important orebody—Murchie mine shaft to be deepened

▶ A new milling plant has recently been completed by the Monarch Mining Company, headed by A. D. Hadsel, situated near the Butcher Ranch, Forrest Hill, some 14 miles from Auburn. The holdings cover part of a large low-grade porphyry belt now under development. Ore mined by open-pit methods is stored in a 5,000-ton storage bin before being trucked to the receiving bin at the head of the mill, which contains a Hadsel pendulum-type grinding mill and a cyanide plant (countercurrent). About fifteen men are employed.

▶ General Mining Company, A. A. Floyd president, is installing equipment capable of handling 1,000 yd. of gravel per 8-hour shift at its property near Belden, Plumas County. A considerable yardage of commercial gravel is reported to be available for treatment.

▶ Reports from Alleghany indicate that the property of the Sixteen-to-One Extension Mining Company, closed since last year, may be reopened and development work resumed, as new funds were voted recently at a meeting of the board of directors. George W. Hallock, of Alleghany, is president and general manager of the company.

▶ Milling operations have been started at the new 100-ton custom mill completed recently at Forbestown by the Butte Central Mining & Milling Company, W. F. Downie, president. A second plant is to be installed near Cherokee to treat custom ore from a number of small mines in the surrounding district.

▶ The Vernon Jay holdings in the Goldstone district near Barstow have been acquired by the Gold Rock Mining & Milling Company, controlled by Tacoma interests, and a 30-ton milling plant is in course of construction. Operations are directed by J. R. O'Donnell, general manager.

▶ Virgilia Mining Company, operating at Virgilia, Plumas County, has resumed operations after brief suspension of mining caused by flooding the lower levels. Severe storms and subsequent failure of electric service closed down the pumping plant for several days. The 150-ton mill, however, was operated without interruption, as sufficient ore was stored in the storage bins.

▶ Extensive improvements are to be made at the Big Blue and Lady Bell mines, near Kernville, operated by Kern Mines, Inc. Development work in progress is part of a comprehensive program started by the company a year ago, and so far six orebodies have been developed or are in course of development. The mill is treating about 90 tons of ore a day, mostly material obtained from stope development. Upon completion of the long-range program of development, the mines may be worked through a central shaft, and future plans include the erection of a 500-ton mill. Eirind Knutsen, general superintendent, is in charge of operations.

▶ The Niagara, Milkmaid, and Washington mines, in Shasta County, are reported to have been taken over by Newmont interest controlling Empire Star Mines Company, Ltd., at Grass Valley. Operations are scheduled to start at once, with C. W. Plumb in charge.

▶ Atolia Mining Company, owner of extensive tungsten properties at Atolia, has completed and placed in operation the new milling plant said to have cost $300,000. Both leasers' ore and accumulated tailings will be treated. Operations are directed by C. S. Dennis, general superintendent.

▶ Moro Bay Copper Company is reported to have opened up what appears to be an important body of copper ore on the 275-ft. level of its mine near San Luis Obispo. The property was taken over by the company more than six months ago, and since then a vigorous development program has been in progress, directed by George B. Guillotte, resident engineer. Ogden C. Chase, of Salt Lake City, is president of the company.

▶ North Canyon Mines, Inc., is preparing to reopen the Droege and New York mines, situated near Greenville. Both properties are developed by tunnels, and sufficient equipment and materials are available to start mining operations. The surface plant at the New York mine also includes a modern 75-ton flotation mill. W. H. Parsons is president and general manager of the company.

▶ Development work undertaken recently at the Murchie mine of Empire Star Mines Company, Ltd., includes sinking a winze from the 2,300 level and lowering the main shaft another 100 ft. to the 2,400 level, where a station will be cut. The property is about 2 miles from Nevada City. At the company's Pennsylvania unit, in Brows Valley, a new 75-ton mill is being installed and the ten-stamp milling plant remodeled. F. W. Nobs is general manager.

▶ Work is progressing satisfactorily on the new 150-ton flotation mill now under construction at the Scotia shaft of Golden Center Mining Company, Grass Valley. About six sets of leasers are now active in the Golden Center mine, and it is planned to treat ore shipped by them in the old 20-stamp mill at the Golden Center shaft after operations have been transferred to the Scotia mine. Nearly 100 men are employed under the direction of W. H. Carey, superintendent.

ARIZONA

Boriana Tungsten Mine Will Have New Mill

Plant destroyed by fire on Nov. 18 will be replaced by new structure—No. 8 shaft of Magma Copper reached 4,000 ft. level

▶ Molybdenum Corporation of America, operating the Boriana tungsten mine, in Mohave County, which recently lost its mill by fire, is reported to be planning the erection of a new plant. Dave Rankin, at Yucca, is general manager.

▶ Minco Mines Corporation, operating the old Minnesota-Connor mine, at Chloride, is making daily shipments of ore to the General Ore Reduction Company, at Chloride, for treatment. Recent developments have disclosed some good shoots of ore and preparations are being made for stoping. George Reed, of Chloride, is foreman in charge of the work.

▶ The overhauling of the mill at the Oro Plata mine, in the Golconda district, is nearing completion. New flotation cells are being installed and mill capacity will be increased. The company has lately acquired control of the Towne and the El Oro properties. E. G. Frawley, of Reno, Nev., is managing

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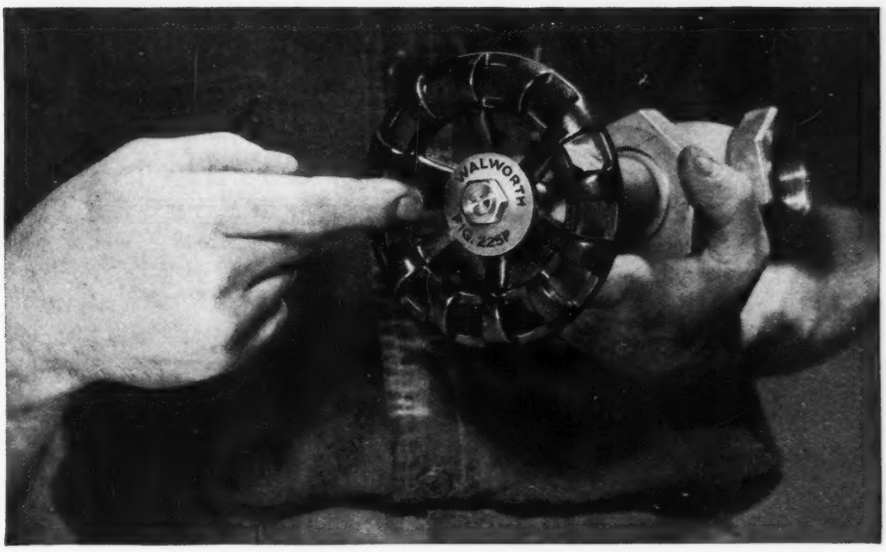

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ARIZONA

the operations. Smilie S. Jones, of Kingman, is consulting engineer in charge.

▶ The National Lead Company, of St. Louis, Mo., recently had its geologists examine a barite property belonging to W. G. Keiser in the vicinity of Quartzsite, Ariz.

▶ The Prout-Baker interests, owners of the Dilsch mine, on the Mother Lode, in California, are making an examination of the Malfern placers owned by Claude B. Storer, of Quartzsite. They are also examining some lode properties in the same district.

▶ The new No. 8 shaft of the Magma Copper Company, at Superior, has reached the 4,000-ft. level; and 3,600 ft. of this sinking has been accomplished during the past two years. The shaft is four compartments and will be used for ventilation and water delivery. A pump is being installed at the 4,000 level which will make the delivery in one lift. Approximately 500 g.p.m. will be delivered at the collar of the shaft. The Magma produced about 30,000,000 lb. of copper in 1937. William Koerner is general manager.

▶ A placer property in Black Canyon near Bumblebee, Ariz., owned by the Golden Bee Mining Company, has completed the installation of equipment, including draglines, trommel, and conveyers, and is in active development of the property. Gordon W. Moore and R. A. Powell, of Bumblebee, head the company.

▶ A shaft being sunk on the Christmas group of claims at Goodwin, Yavapai County, has reached a depth of 70 ft., and has found 14 in. of silver-lead ore on the hanging wall which is said to average $73 per ton. Shaft sinking will continue to the 100-ft. level, where drifting will start. Ernest Rork and William Fales are owners of the property.

▶ The Mammoth-St. Anthony, Ltd., at Mammoth, Ariz., has installed a 5 by 10 Marcy rod mill for primary grinding. Foster S. Naething, of Tucson, Ariz., is general manager.

▶ The Arizona Magma Company, at Chloride, operating the old Diana mine, has been finding considerable ruby silver in the lower levels. Cliff Carpenter is general manager.

▶ The new mill on the Lum property, in Deluge, Wash., in Mohave County, has started operations. This property is in the southern part of the Hualapai Mountains. Sufficient water has been developed for mill operation. Several properties in this section will produce ore for the mill as well as the property owned by the Lum interests. Albert Lum is in charge of the operations.

▶ Ventura Mines, Inc., contemplates resuming operations during the spring months following a shutdown since April 4 last year. Ore containing copper, silver, gold, lead, and zinc is developed in eight tunnels. A pilot flotation plant is planned following metallurgical tests. E. B. Holt, of 515 Morley Ave., Nogales, is engineer for the company.

▶ The Gold Standard Gold Mines Company has taken over the Thumb Butte mines, in Mohave County, and is preparing to ship ore to the company's mill at Katherine. The plant is treating about 250 tons daily. Richard de Smet is general manager.

▶ H. E. L. Mining Company is equipping the Pontiac mine, in the Golconda district in the Cerbat Mountains 15 miles north of Kingman. H. G. Hume, of Los Angeles, consulting engineer, is in charge of operations. E. B. Huse, of Long Beach, Calif., is president of the company.

UTAH

Utah Copper Tunnel Project Makes Good Headway

Bore expected to hole through soon—Miners and operators negotiate on 1938 labor contract

▶ By the end of February, the Utah Copper Company expects to complete its 6,976-ft. bore from lower to upper Bingham. This million-dollar vehicular tunnel, 16 ft. 4 in. wide by 18 ft. 2 in. high, with a semicircular arch of 8 ft. 2 in., had been driven on Jan. 20 6,145 ft. since being started on April 15, 1937. About 341 ft. has already been concreted. The grade will be 6.43 per cent. Progress has been about 25 ft. daily. As soon as the driving of the tunnel has been completed, installation of lights and cable and pipe lines will be started and the whole length concreted. On or before Aug. 1, it is planned, the tunnel will be ready for use by pedestrians and motor vehicles.

▶ The National Tunnel & Mines Company tunnel being driven from Tooele to furnish drainage and transportation for the Bingham properties of the company had been driven 5,380 ft. on Jan. 20. Progress is averaging 20 ft. daily. At a point 4,300 ft. from the portal, the company reduced the size of the bore to 8x8 ft. The formation is still in alluvial wash, but within another 1,000 ft. the company expects to enter rock formation.

▶ Mine, mill, and smelter operators have been conducting negotiations with officers of the International Union of Mine, Mill and Smelter Workers, District No. 2, relating to wage contract for the current year to replace that which expired on Dec. 31. James W. Wade, general manager of the Tintic Standard Mining Company, was named spokesman for employers after the death on Jan. 11 of W. Mont Ferry, managing director of the Silver King Coalition Mines Company. Both sides report that progress is being made toward an amicable settlement of all points under discussion.

▶ Between 2,800 and 3,000 tons of ore is being treated weekly by the Mercur milling unit of the Snyder Mines, Inc., at Mercur. Mill feed consists of ore from the Mercur mines of the company and tailings from the old dumps. A large production is coming from an open cut, where a bedded deposit 25 to 30 ft. wide has been exposed. The Geysey-Marion company is also operating its mine and mill at Mercur.

▶ Operations at the new mill of the Lakeside Monarch Mining Company, 50 miles west of Salt Lake City, have been temporarily suspended pending the completion of metallurgical tests at the Bureau of Mines plant, Intermountain Station, University of Utah, Salt Lake City. A promising outcrop of silver-lead ore is being explored 3,000 ft. southeast of the tunnel portal. Assays carry, according to Manager George H. Short, Continental Bank Building, Salt Lake City, 20 per cent lead and 3 oz. of silver to the ton.

▶ The Tintic Ophir Mines Company, of which Frank E. Porter, Newhouse Building, Salt Lake City, is general manager, reports production for 1937 is more than double that of 1936. Over 15,000 ft. of workings are now open for further development. The company plans to increase compressor capacity so as to augment its operations through leasers.

▶ Col. D. C. Jackling, president of the Utah Copper Company, went to Salt Lake City Dec. 30 to attend the "old-timers' dinner" at the Hotel Utah. Over 300 employees were present. Gold medals, certificates, and lapel buttons were presented to all employees whose service records attained the twenty-year mark within the last six years. A total of 44 became eligible for the twenty-year medals during 1937. General Manager D. D. Moffat presided as toastmaster.

▶ The Utah Consolidated Mining & Milling Company passed to the control of the Mammoth Mining Company with the election of a new board of directors consisting of Earl McIntyre, Roy A. McIntyre, Earl F. Dunn, Robert E. Mark, Frank A. Johnson, P. S. Roberts, and R. H. Allen. The Utah Consolidated property of 35 acres adjoins the Mammoth mine at Eureka on the northeast. Drifting is being done to cut the intersection of the Lillian and Flagstaff fissures.

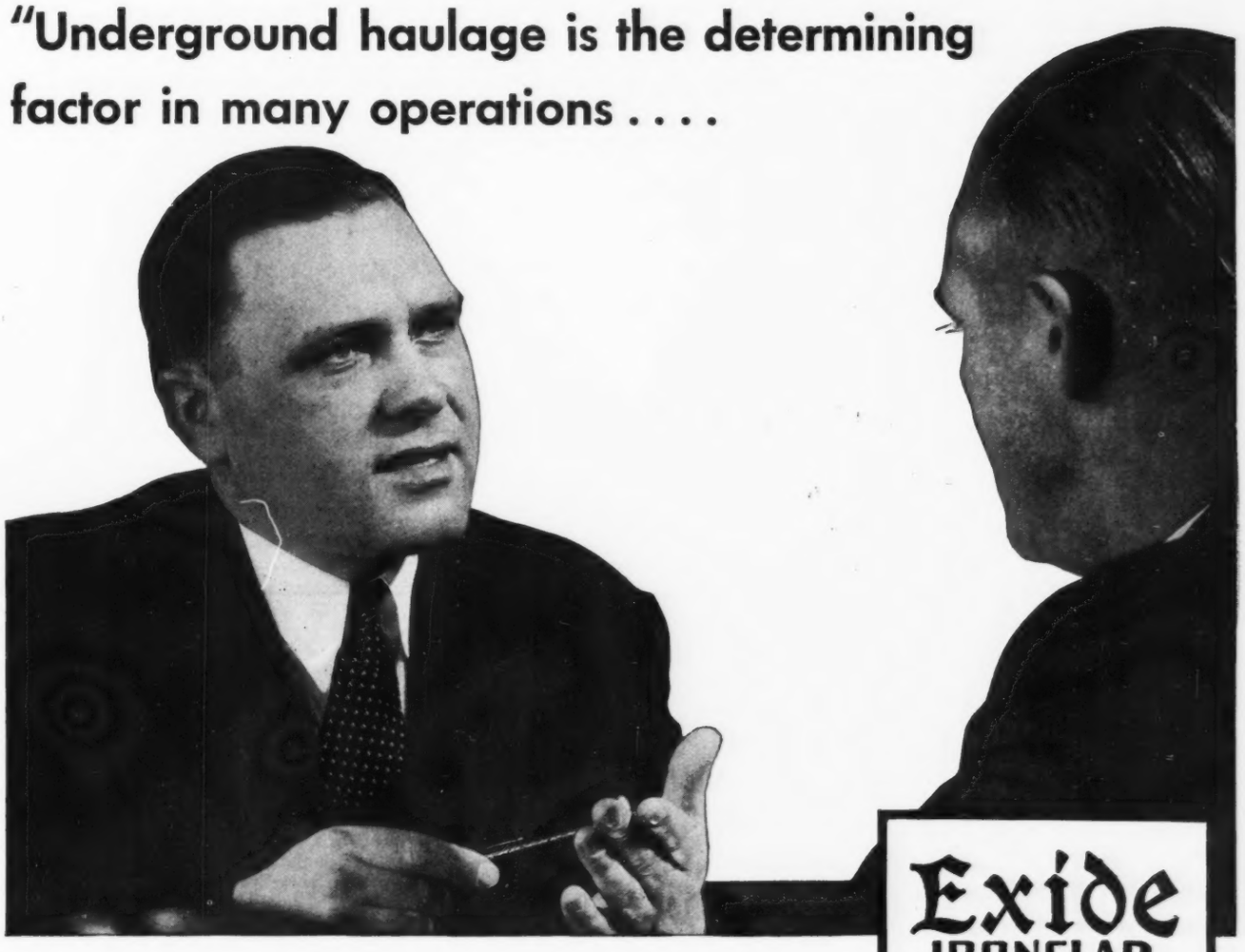
MONTANA

Emma Zinc Mine and West Colusa Copper Mine closed

Curtailment of base-metal production becomes sharper as business recession continues—Flotation plant to treat gold-copper ores under construction at Gold King property

▶ Production from the Butte district was further curtailed on Jan. 21 by the closing of the Emma Zinc mine of the Butte Copper & Zinc Company operated by the Anaconda Copper Mining Company. The action was necessary to check the increase of zinc concentrates now being stockpiled at the Great Falls plant.

"Underground haulage is the determining factor in many operations . . . .



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▶MONTANA

About 230 men will be affected, although development work will be continued with a crew of about 50 men. On Jan. 26 the company closed the West Colusa copper mine, further curtailing output of copper. About 500 men were laid off.

▶ An accident in the shaft of the Boaz mine on Jan. 8 released a cage which fell to the bottom (300 level) carrying Jack Warner to his death. A. F. Van Slette, miner, also in the cage, was uninjured.

▶ Early in the morning of Jan. 10, a fire of undetermined origin completely destroyed the 150-ton mill of the Ardsley Butte Mining Company situated a few miles southwest of Butte. According to T. Tomich, Butte representative of the company, the loss amounted to about $20,000. No damage was done to other buildings. The mill had not operated since 1931. Subsequent to 1931, the silver mine has been intermittently operated by Frank McNulty and lessees.

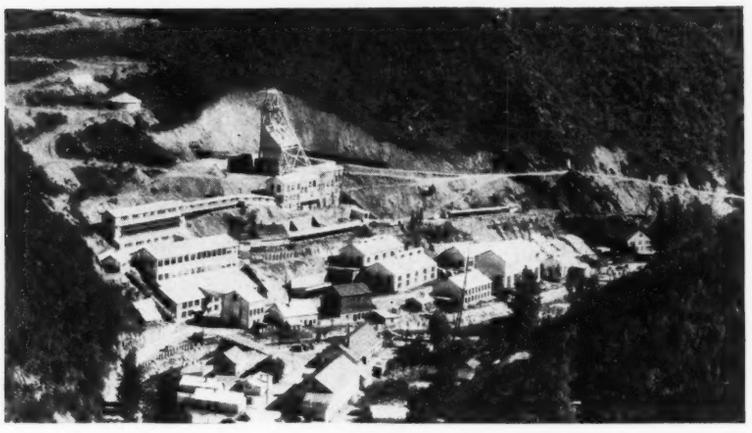
▶ A flotation plant is under construction at the Gold King property, near Maxville, operated by C. D. Terwilliger and associates, of California. Subsequent to taking over the property in May, 1937, shipments aggregated approximately $70,000 of gold-copper ores. E. W. Harker, of Silver City, Nev., is consulting engineer, and E. N. French, of Maxville, is superintendent at the property.

▶ According to T. M. Raymond, one of the former owners, the Bartlett mine, near Virginia City, has been sold to Buck Healin, of Missoula. The property consists of nine claims situated near the head of Alder Gulch. A compresser and other machinery have been moved to the property and a few men are working, preparing for production in the spring.

▶ I. B. Haviland, of Oak Park, Ill., has consummated a plan whereby he will reopen the Golden Leaf mines, at Bannock, in conjunction with the Shafer mine, on French Creek near Argenta. Gold ore from the latter will be trucked to Bannock and treated jointly with Golden Leaf ores in the company's 150-ton cyanide plant.

▶ Leasers operating the Copper Cliff mine of the Potomac Copper Company shiped 22 cars of ore to the Washoe smelter of the Anaconda Copper Mining Company during eight months in 1937. William P. Jahn, of 2627 East Newberry Boulevard, Milwaukee, Wis., is president of the Potomac Company. Plans are reported under way for construction of a mill.

▶ Copper production in Butte during 1937 was valued at $34,791,130, compared to $20,156,096 in 1936. Metal output increased from 219,088,000 lb. to 287,580,000 in 1937. The power shortage during the summer did not affect copper production, since most of the deficiency affected electrolytic zinc production. Lead output decreased from 38,118,000 lb. in 1936 to 37,370,000 lb. in 1937. Zinc output dropped from 99,340,000 lb. in 1936 to 78,054,000 lb. last year.



From the mill shown on the left, Sunshine Mining Company recovered 12,027 tons of concentrates that netted 12,146,853 oz. silver. Output in 1936 was 9,103,113 oz.

IDAHO

New Production Record Made at Sunshine Mine

Silver output was 12,146,853 oz., compared to 9,103,113 oz. in 1936—Gold and silver producers continue active operations

▶ The Sunshine Mining Company set an all-time production record of 12,146,853 oz. of silver in 1937, and netted a profit of $5,401,457.58, according to R. D. Leisk, general manager. These figures compare with production of 9,103,113 oz. and net profit of $3,966,825.30 in 1936. Last year the company paid $4,466,463 in dividends out of the net profits, compared to $3,349,847.25 in 1936. During the year, 12,027.5 tons of concentrate were produced with an average assay of 48.2 oz., tailing assay of 0.86 oz., and concentrate assay of 1,009.9 oz. to the ton; 701 tons of ore were put through the mill daily which produced an average of 33 tons of concentrates. The per cent of extraction averaged 98.3 and the ratio of concentration 21.3 per cent for the year. Mr. Leisk stated that four new 60-passenger buses were put in operation on Dec. 1 to transport the workers to and from work without charge.

▶ The cut in the price to be paid for newly mined silver to 64.64c. an ounce affects all of the mines of the Coeur d'Alene district, especially the Sunshine and Polaris. With the Sunshine now turning out about one million ounces per month, the reduction becomes an important item in the year's business with the United States mint. At the Sunshine the cost of producing an ounce of silver is reported at 31⅛c., leaving 33c. of profit. Opinions of leading mining men of the Coeur d'Alenes on the new silver price follow: R. M. Hardy, president of Sunshine Mining Company: "So far as Sunshine is concerned we'll get along very nicely at the new price." Stanly A. Easton, president of the Bunker Hill & Sullivan: "I think it is quite all right. It is the logical price." James F. McCarthy, president of the Hecla Mining Company: "I was disappointed. It cuts 13c. from the profit, but it is lots better than nothing."

▶ The Ranger property of Equities, Inc., on the Continental Divide near Salmon, completed a successful season, according to E. F. Fitzhugh, Jr., manager. A 25-ton daily capacity stamp mill is recovering between 89 and 91 per cent of the gold. About 40 men are employed.

▶ Gibbonsville Mining & Exploration Company recently purchased a 200-ton mill at the Harmony mines and has moved the equipment to its property, expecting to have it in operation in a few months. Philo Seelye, Gibbonsville, is president.

▶ James O. Galloway and associates, of Boise, have taken over a group of claims at Mountain City, Nev., near the famous Rio Tinto mine, for a reported purchase price of $375,000. Former owners of the ground are the Copper Mountain Mines, Inc. Associated with Galloway in the new Idaho-Nevada Copper Corporation, Ltd., are Kenneth Jensen, Charles F. Jensen, Harvey H. Brown, and Jack Patten, all of Boise, and Postmaster John Cato, Earl Wolfe, J. N. Patch, and B. J. Dunten, all of Meridian, Idaho.

▶ Important ore disclosures have been made in the new vertical shaft at the Liberal King mine, on Pine Creek, Coeur d'Alene district, now down 150 ft. in the descent toward the 500 level. A two-inch silver-lead stringer found on the tunnel level has widened to 2½ ft. in the shaft. Clem J. Whittemore, of Seattle, is president, and Henry Weber, Rose Lake, Idaho, superintendent, of the property.

▶ Directors of the Jack Waite Mining

Company have declared a dividend of a cent and a half per share, payable Feb. 21. The disbursement amounts to $41,-316.46. Jack Waite is operated by the American Smelting & Refining Company, the Federal Mining & Smelting Company officials being in charge of the work on a percentage basis with the Jack Waite company. From 50 to 75 men are employed in mine and mill operations, located in the Eagles district, north of Wallace.

▶ The Polaris main operating shaft is now well under way to the 2,000-ft. level, according to President James F. McCarthy, of Wallace. The new work started from the 1,500 level, where production is now under way. A daily production of 160 tons of ore is being handled by the mill.

▶ Great Western mine, Little Lost River Valley, shipped a carload of lead-silver ore recently that assayed 31 per cent lead. Shipments are being made from the croppings of high-grade ore discovered a short time ago. Judge F. J. Cowen, of Blackfoot, Idaho, is operating the property under lease.

▶ Treasure Knob Mining Company has installed a pilot mill on its gold property in the Bear Creek section of the Marshall Lake mining district in Idaho County, and a larger mill will be erected this year, according to R. H. Russell, of 1714-12th St., Spokane, Wash.

▶ The Lone Pine mine, at Golden, has been sold for $250,000 to the North American Mines Company, Boston, Mass., which operates as the Gold Belt Mine Corporation, Vancouver, B. C. F. O. Miller and S. O. Miller, of Lewiston, Idaho, were the owners of the property, which in 1935 and 1936 produced 10,155 tons of gold ore worth $107,-693.95.

▶ Silver Summit Mining Company will start work at once on the sinking of a 1,000-ft. vertical shaft, according to Harry A. Pearson, president-manager, of Wallace. The Silver Summit, a short distance east of the Sunshine, has a wide siderite vein containing silver exposed for a distance of more than 1,000 ft. on the main tunnel level.

▶ The Ione property, Murray district, will renew operations this season, the management planning to drive the lower tunnel 400 ft. to cut the vein. O. M. Nordquist, of Wallace, is president-manager, and L. L. Brainard, also of Wallace, secretary.

▶ Gold Producers, Inc., have taken over the Grunter mine, located below Shoup, in the Salmon River district. The ore will be hauled to Gibbonsville for milling, with a mill to be constructed at the mine at a later date. L. L. McLean is president of the Gold Producers.

▶ Mineral Mountain M. & M. Company has completed plans for enlarged operations that include shaft sinking to the 500-ft. level. Ore has been reported found in a strong vein 15 ft. wide in the tunnel level. Further shaft sinking is planned to determine this vein in depth. Fred Theil, of Wallace, is president.

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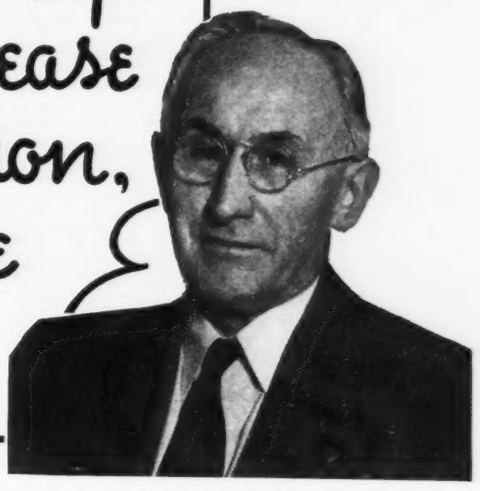

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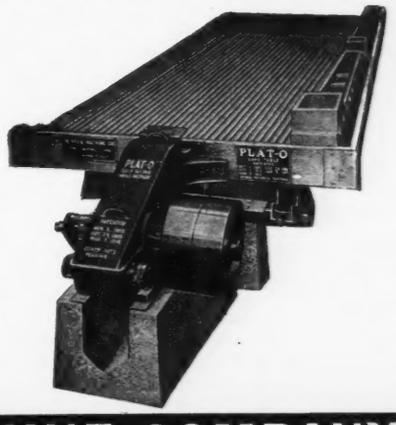

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NEWS FROM Washington

By Special Correspondent

COOPERATION is the theme song of the Washington chorus, in which Government, business, and labor leaders are all singing lustily. But each seems to define cooperation as "getting the other fellow to do it my way." Progress toward joint action to stem recession influences has, therefore, been small during January.

Congress seems far more responsive to business-man comments than is the President. It might legislate fairly effectively on several points regarding which business urges action, if it only knew just what enactments to approve. Unlike the White House, Capitol Hill clearly distinguishes between objectives and the methods for reaching them.

Mexican Deals

WASHINGTON seemed to think that it had its relations with Mexico fairly well fixed up in early January, when it established an arrangement with Mexico for further regular purchases of silver. Most important in stabilizing Mexican affairs was the agreement immediately to purchase 35,000,000 oz., with an assurance that thereafter monthly purchases of 5,000,000 oz. would be made by the Treasury at the pegged price of approximately 45c.

Official satisfaction with this arrangement was rudely shattered later in January, when Mexico City announced a large increase in tariff duties, some of them amounting to 400 per cent. In explaining this, Treasury Secretary Suarez stated that the increases are "a necessary step to stabilize the peso." The State Department through Ambassador Josephus Daniels has made protests at Mexico City; but there is no evidence of an easy way in which to reestablish a satisfactory trade arrangement, unless the Mexican Government backs down, which apparently is not expected.

On Jan. 21 the Treasury announced that during last year it had bought $1,502,000,000 of gold and 312,000,000 oz. of silver. The silver purchase included 242,000,000 oz. of foreign silver, purchased at about 45c., and 70,600,000 oz. of newly mined domestic silver. These figures disclose that the Treasury made no significant progress toward the establishment of the wanted higher ratio of silver to gold in the metallic reserve.

Strategic Minerals

DESPITE difficulties encountered by the Navy in purchasing manganese, chromium, and other metals for its strategic mineral reserve, the House of Representatives again proposes an additional fund for this purpose. In the Navy appropriations bill, passed by the House Jan. 21, $3,000,000 is provided, for addition to the $3,500,000 of last year not yet expended. Under the provision that the Secretary of the Navy shall determine what materials are "strategic and critical," it is expected that reserves will be first established for manganese, tin, antimony, tungsten, chromium, and quicksilver.

The Senate Military Affairs Committee is also concerned about these matters. It has ordered a subcommittee to begin an investigation of sources of supply of those minerals necessary for national defense purposes. At the hearings scheduled to open early in February, experts from the military departments were asked to lead off the discussion. The stated objective is "to determine the amount of such strategic minerals on hand with a view to establishing a tentative program for obtaining sufficient amounts to ensure against a shortage in the event of a crisis." This study may produce some real facts persuasive to the Senators. But it is not likely to lead to any different conclusions than have already been set forth frequently by the Bureau of Mines and in communications from the War Department to Congress.

Most novel and significant is the idea that probably Congress will take account of the adequacy of present commercial stocks in the hands of major users.

BUSINESS AIDS

RECOMMENDATIONS to Congress and to the President regarding things which the Government can do to help business seem unanimous on two points. The undistributed-profits tax and the capital-gains tax should be repealed, or substantially changed to eliminate present barriers which they erect in the way of business expansion. On scores of other subjects recommendations are made with varying degrees of vigor and definiteness. Perhaps the Chamber of Commerce of the United States, speaking through President George H. Davis, has come nearest to crystalizing business sentiment. Five "of the most serious obstacles to immediate expansion in business and employment" were cited as follows:

"1. The uncertainties to business, produced by the threat of new and drastic regulatory legislation, providing Federal control of hours and wages, together with the imposition of onerous restrictions on corporations doing interstate business.

2. The barriers to business expansion produced by Federal tax legislation, including particularly the undivided-profits tax and the capital-gains tax.

3. The dangerously large proportion of national income being collected in taxes to defray the expenses of government.

4. The intrusion of Government into relations between employer and employee.

5. The need for liberalizing some of the existing laws and regulations covering the flow of capital."

Alaska Platinum

INCREASE in placer platinum facilities at Goodnews Bay, Alaska, with the aid of R.F.C. funds, has occasioned special Government attention to that development. Dr. J. B. Mertie, Jr., of the United States Geological Survey, has made a recent reappraisal of that area and reported on it in December to the Society of Economic Geologists. Dr. Mertie's comment on the prospects of enlarged platinum output is based primarily on the increased bucket-dredge facilities which have been provided, equipment sufficient to handle four to five times the pay dirt previously handled.

There appears to be no reason to doubt the Alaskan hopes that the platinum output will be proportionately increased four or five fold from the present 4,000 to 5,000 oz. of output per year in this area. But there is no official confirmation of the rather extravagant newspaper headlines which forecast that at least 10 per cent of the world's supply of platinum will soon come from this one operation.

Research Desired

IN HIS ANNUAL REPORT the Director of the Bureau of Mines cites a number of new projects on which the Bureau wishes to carry forward investigations in the near future. Many of these recommendations relate to safety, fuels, or other phases of the Bureau activity. Most important to the mining industry among the new or enlarged activities recommended are the following:

"Additional personnel is also needed to meet the widespread demand for reports on mining and milling methods and costs, to keep abreast of improvements in mining technology, and to aid small-scale operators and prospectors through technical reports, mineral-industries surveys, and personal visits by Bureau field engineers.

"The number of non-metallic minerals is so great, and the variety of things that might be done with them by using cheap electric power is so numerous, that a study of the processes using hydro-electric power in preparing them for market is urgently needed, especially in view of the Government's interest in a number of projects where such power is available.

"There is also need for facilities with which to develop laboratory metallurgical processes devised by the Bureau to the pilot-plant scale of operations. This would make it possible to demonstrate commercial applicability of the processes and thus provide an incentive for their adoption by industry. The laboratory process using sound waves to precipi-

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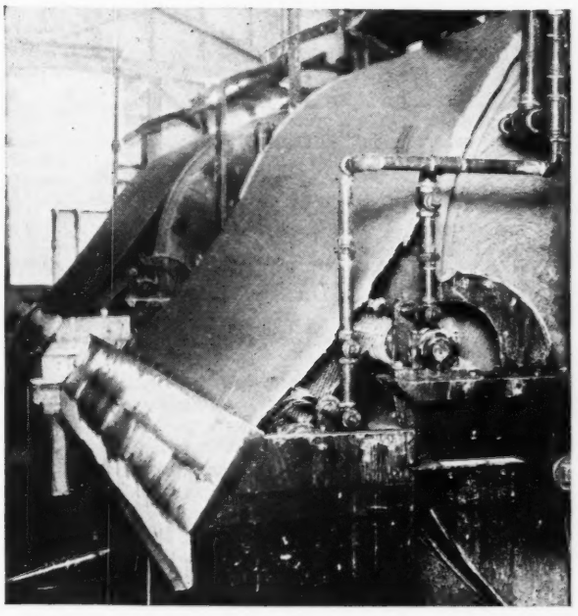

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tate solids from smelter fumes or smoke from chimneys is a case in point.

"Outstanding achievements in mineral technology during the past 30 years have greatly changed the quantity of minerals that can ultimately be made available, have had a sharp effect upon competitive positions of different mining areas, and have reduced mining costs. In consequence, the Bureau of Mines is called upon constantly to advise mineral producers as to the amount of a specific mineral that can be produced economically or consumed at a specific price, and as to the effect of price fluctuation upon the stability of various branches of mining. In order to answer these questions, and to provide mineral producers with authentic price data for their guidance, new research must be undertaken to develop information on mineral prices comparable to that available in the fields of commerce, manufacturing, and agriculture."

Mine Tax Recommendations

AMERICAN Mining Congress also has spoken definitely on behalf of the mining industry, through Secretary J. D. Conover. Its recommendations regarding tax amendments, which follow the plan advocated by business men generally, also portrayed the special resources development problems created by present tax levies. The following portion of Mr. Conover's statement to Congress is particularly significant as outlining sound industry accounting as well as sound tax policy:

"The undistributed-profits tax has particularly obstructed the development of new mining enterprises and has hindered the restoration of properties which have been shut down or been curtailed during the depression.

"Mining enterprises begin with prospecting, carried on by an individual or a small group. Perhaps years are spent in reaching a point where actual expenditure of considerable sums of capital are warranted by the developments which have taken place. When this point is reached, two courses are open: either the owners of the property, who have spent years of labor in bringing it to this stage, must in order to secure new capital, surrender a large equity in that which they have created themselves, or they must pour back into the enterprise earnings which are derived from operation.

"This brings about a situation where the operation of the undistributed-profits tax works a serious hardship. Frequently the corporation has agreed to pay for the property a sum of money over an extended period. If the undistributed-profits tax is continued in its present form or even in the form suggested in the report of the subcommittee, a hardship will be worked upon those who have devoted their lives and efforts to the operation thus far. They are obliged to distribute the earnings which have accrued or pay a heavy tax upon any sum which they devote to payment for the property. Then again, when the productive stage is reached, concentrating plants must be built. Considerable additional money must be used for the purpose of development of orebodies which have been discovered. All of this in the ordinary course of things should be paid out of current earnings. It will be readily seen that the operation of an undistributed-profits tax will work a decided hardship upon these men who have contributed so much to bringing into productive operation enterprises which will add to the wealth of the nation.

"Under the proposed plan, a 20 percent tax will be placed upon the proceeds of such enterprises which are devoted to payment for the property itself, to purchase of new equipment or to the erection of the necessary plants for operation. The present system of income-tax computation which requires capitalization or deferred deduction of many of these expenditures—which ordinarily and necessarily absorb all or a substantial part of the current proceeds of mine production—results in a showing of taxable income even though the funds have been absorbed in these necessary expenditures for development and equipment of the property.

"This is not a matter for argument as to income-tax theory, but a practical situation which confronts the mining investor. Manifestly, there are some prospects which would not be developed against the 32 percent tax and which would be developed against the 20 percent tax; but there are many, the development of which will be obstructed by a 20 percent tax rate.

"The provision for tax upon closely held corporations applies also to many mining properties which have been developed in the manner we have endeavored to describe. It seems to us a cruel procedure to require a group of men, who have labored and toiled over a period of years and have uncovered wealth through their efforts, to capitalize their corporation in such a manner that the profits of those efforts shall go to those who have merely contributed capital after the value of the property has been demonstrated.

"We urge that some provision be made which will allow mining properties to deduct from income, to the amount of such income, those expenditures which are currently made for development, equipment and upbuilding of the mine."

METAL PRICES

DEPRESSION business conditions breed DEflation, but "recession" politics breed INflation. Late in January the two influences were about offsetting each other in Washington. That the inflation bogey should have again raised its head surprised Administration leaders greatly. They did not expect, nor did the President intend, this consequence of his message to Congress. But that message's prophecy on national income reaching $100,000,000,000 *per year could not otherwise be understood by economists, especially those of orthodox or Old Deal leanings.*

AN INTERPRETATION of that episode is probably not important in itself. But it does lead to some appreciation of the Washington fiscal problem, and the factors which make Government spending such a potential threat to business financing.

THE PRESIDENT has found that he cannot curtail Government spending. He is going to keep trying, with some minor victories, but he has concluded that he must have $7,000,000,000 *per year for Uncle Sam's Treasury. He has discovered he cannot take that much away from taxpayers, except when the national income is higher than it is likely to be in* 1938. *Therefore he concludes that the national income must be made higher. He seems to say to himself (and to even let the public in on his whispering) "We did it in* 1933, *why not again?" But realists know that the only two ways to boost further the national income are much increased business or inflation. They don't see the big business boom. They infer that the President must plan inflation. Probably, he did not plan this, did not even intend to imply it. But the reasoning which followed his message does almost as much to upset business financing as if the intention and plan had been as the critics infer.*

ALL THIS fairy story has only one moral to the realists. Overemphasis on Washington is common and may be dangerous.

Electrometallurgy

PRESSING ITS STUDIES for new uses of electricity in the enlargement of metallurgical industries, the Bureau of Mines, in cooperation with the State College of Washington, at Pullman, has issued an extended report on "Present Outlook for a Magnesium Industry in the Northwest." From limited laboratory-scale tests, and somewhat more extensive economic appraisal, Bureau writers conclude that "a period of phenomenal growth" is in progress. Arguing from the availability of cheap power, the report expounds the possibility of magnesium developments from the abundant magnesite resources, either by the normal electrolytic method or by some new procedures suggested in this document.

At one point the report states "there is every indication that direct reduction with carbon may eventually produce magnesium at much lower cost than by the older methods." The advantages cited are that (1) no purification of the raw magnesite is required and (2) less electric energy is needed than in the standard electrolytic process. The major limiting factor which troubles the authors is a lack of an expanding market for magnesium in quantities adequate to justify large-scale production by the new process proposed.

This report is but one of a series of evidences of the vigorous struggle by technical, as well a economic, units of the Government to provide markets for surplus electric output at the more remote power plants. Many of the proposals which are apparently receiving some serious attention are still more theoretical than these admittedly undeveloped magnesium processes.

Two major difficulties lie ahead for the Valley power enterprise. The open break between Chairman A. E. Morgan and his associates, Dr. H. A. Morgan and Mr. David E. Lilienthal, forecasts an inevitable Congressional investigation, in which the integrity of high officials may be brought into question. Certainly some change in the T.V.A. administration is to be expected, in view of the abandonment of even an appearance of teamwork on the part of the three Directors.

The second complication in Southern power development which definitely affects metallurgy comes from the Federal Power Commission. That agency handed Carolina Aluminum Company and a number of neighboring power enterprises a most unwelcome Christmas present. The Commission invoked its authority to initiate investigations against these companies, claiming that their contemplated and current developments on the Yadkin River could not proceed without the official blessing of a license from the Commission.

The fundamental issue to be fought through in this group of cases is really a definition of the limits of the authority of F.P.C. The Commission, of course, assumes that it can control *all* facilities affecting water supply, clear back to Farmer Jones' cow-pasture creek, on the theory that this affects a navigable stream far below. The pending cases before the Commission are likely to determine somewhat more definitely the scope of this authority.

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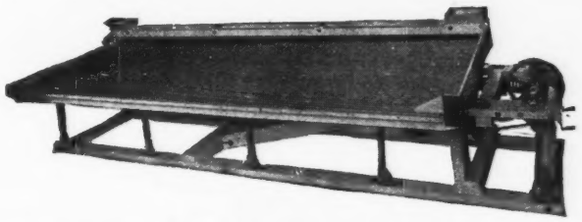

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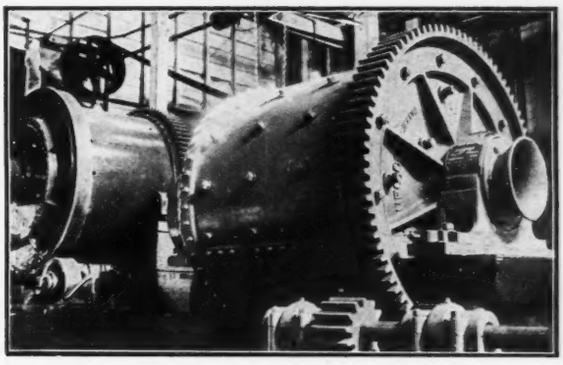

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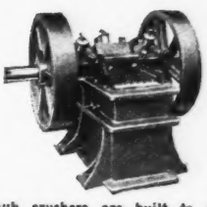

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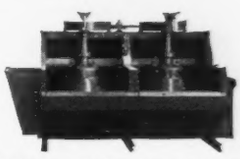

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For complete details of Sauerman machines, their uses and method of operation, write for Catalog 18.

There are several types of Sauerman machines and each type has a well-defined field of use.

Above is shown a Sauerman Tower Machine building an earth dam across a valley to form a huge tailings reservoir. The sketch below shows how a Tower Machine stores ore, coal, etc. in a long, high pile and then reloads the stored material into cars.

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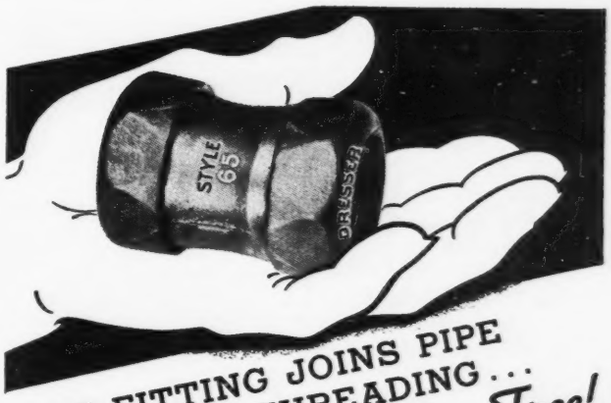

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COLORADO

Vanadium Corporation's Mill Completed

About 250 tons ore treated daily—Rico Argentine pursues active development campaign—Colorado Mining Association meets in Pueblo

▶ The United States Vanadium Corporation, at Uravan, Colo., about 85 miles southwest of Grand Junction, has completed its plant enlargement and is treating about 250 tons daily. Blair Burwell is general manager. W. G. Haldane, assistant to Mr. Burwell, has been appointed superintendent to construct a new mill for the company, to replace the present mill at Bishop, Calif.

▶ A new strike has been made at the property of the Rico Argentine Mining Company, at Rico, Colo. Development headings have been advanced over 1,100 ft. in about 75 days, according to C. T. Van Winkle, consulting engineer.

▶ The La Plata Mountains, known as the California mining district, located in La Plata and Montezuma counties, have rewarded every diligent and consistent operator with at least a modicum of success, yet no great producing orebody has been uncovered. This is due to several factors, chief of which is the refractory type of ore, economical treatment of which has not been satisfactorily understood. The San Juan Milling & Refining Company, headed by John A. Pratt, was the most active during the year and plans the full development of the old Doyle property, near Mancos. Other operators in this district are Pioneer Gold Producers, Inc., operating the old Idaho Mine, and the Red Arrow, under the direction of George Gilmore and the Starr Brothers.

▶ The new mill constructed by the Creede Mills, Inc., at Creede under the supervision of W. B. Jacobsen, vice-president and mill superintendent, is treating around 100 tons custom ore per day.

▶ The Telluride mining area has witnessed many improvements during the year. Perhaps the major event has been the development of the Veta Mines, Inc., operating the famous Smuggler mill and group of mines under the direction of Robert H. Sayre, president and general manager. Chas. Glasgow is general superintendent.

▶ The Butterfly Consolidated Mines, Inc., have taken over 62 claims of the Silver Bell group, thereby adding to their holdings in the Ophir territory, where the mill has been remodeled and enlarged for spring work.

▶ The Shenandoah-Dives company under the direction of Charles A. Chase, has operated continuously during the past year, and has milled nearly 200,000 tons of its own ore and some 18,000 tons of custom ore. The company ores are practically free of zinc, but the custom ores from some sections contained more zinc.

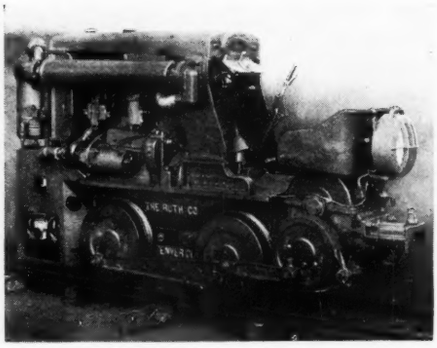
▶ The King Lease on the Camp Bird, Ltd., has operated its mine and mill continuously. San Juan Metals Corporation has completed its building program at the Treasure tunnel property 14 miles from Ouray, and the new 300-ton modern flotation mill is in operation. The Treasure tunnel has been electrified and new track layed throughout; two 4-ton locomotives are used for haulage purposes. Julius Warner, of Denver, is general manager and consulting engineer.

▶ The 25th annual convention of the Colorado Mining Association and the Colorado Chapter of the American Mining Congress was held in Pueblo, Colo., Jan. 10 and 11. "Safety Practices and Their Importance in the Operation of Mines, Mills and Plants" was discussed by A. H. Zeilinger and Charles Devore, of the Colorado Fuel & Iron Company; "The Co-operative Geological Survey" was presented by Dr. C. W. Henderson, supervising engineer of Western Field Offices, United States Bureau of Mines; "The Care and Treatment of Mill Tailings, Comparative Costs, and Methods" was presented by Charles A. Chase, general manager of the Shenandoah-Dives Mining Company; "Some Interesting Phases of the Geology of the Cripple Creek District" were presented by Fred C. Carstarphen; "The Romance of the Rare Metals" was discussed by Samuel Schultis; also "The Hydraulic Basis for Handling Slimes"; and many other interesting mining and milling phases and discussions of various operations concluded the program.

Can you use a DIESEL Locomotive underground?

U. S. Bureau of Mines Bulletin R.I. 3320, Nov. 1936, reported 189 Diesel mine locomotives in service underground in Germany; 39 in Belgium; 191 in France; "At the present time Diesel engines (mine locomotives) are in use successfully underground in one coal mine and in about half a dozen metalliferous mines in Great Britain." With fuel oil at 12 cents per U. S. gallon, a large coal mine in Scotland is hauling for 2.24 cents per underground ton mile.

One of the largest gold mines in the Philippines, after 6 months' satisfactory underground operation of the Ruth "Deselmule" *has ordered another.*



Ruth 3-ton "Deselmule" with Buda Lanova 49 hp. engine for 18" gage track. Overall dimensions: Width 33"; height 4'6"; length 9'; 2,000-lb. drawbar pull; maximum speed 12 m.p.h. with 4 speeds in either direction.

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IRON COUNTRY

Cuyuna Range More Active This Winter

Some operators stocking ore from underground development—Stripping and repair programs continue unchanged

▶ On the Cuyuna range the Merritt mine of Butler Brothers is operating underground and stocking ore. The Inland Steel Company is operating the Armour No. 1 mine, also an underground property. With the Mahnomem and Sagamore mines of Pickands, Mather & Company also doing some winter repair work, this country is more active at this time than for several years.

▶ Mining concerns in Minnesota are continuing stripping programs and repairing equipment, employing a skeleton organization during the winter months. The Oliver Iron Mining Company is employing men on stripping programs in practically every town in which the company is operated. Pickands, Mather & Company are stripping at the Scranton mine, at Hibbing, Minn., and the Danuble, at Bovey, Minn. Lower Lake iron ore at docks and furnace yards approximated 40,000,000 tons on Jan. 1, 1938.

A.I.M.E. Will Convene at 148th Meeting

▶ From Feb. 14 to 17, members of the American Institute of Mining and Metallurgical Engineers will meet in New York City to hear reports and discussions on the latest technical progress achieved in mining, milling and smelting. Other phases of the industry will be presented by papers on the following subjects: Aerial Geologizing, Health and Safety in Mines, Trend in Iron Ore Concentration, Industrial Minerals, and Mining Geology. Of special interest will be the "All Institute" session at which Dr. Harold G. Moulton, president of Brookings Institute, will speak. His subject will be, "Interrelations of Technology, Economics, and Government in a Balanced and Progressive Economy." Dr. Leo Wolman, professor of economics at Columbia University, will take as his timely subject "Labor and Capital."

The dinner-smoker will be held on Feb. 14 and the annual reception and dinner will be Feb. 16, both at the Waldorf-Astoria. President R. C. Allen will preside as toastmaster, the James Douglas Medal will be presented to Hal Williams Hardinge, the Anthony F. Lucas Medal will be presented to Henry L. Doherty, and D. C. Jackling, president for 1938, will be inaugurated.

NEVADA

Mountain City Copper Prospecting on 700 Level

Orebody on 600 ft. level found to extend downward — Options on gold properties increase — Deposits of antimony to be developed

▶ The Mountain City Copper Mining Company is prospecting on its 700 or lowest level to cut the extension of the orebody on the 600 level, opened up for a width of 100 ft. A total of 260 men are employed in the mine and mill. Concentrates are hauled part to Elko, Nev., a distance of 83 miles, and part to Mountain Home, Idaho, a distance of 117 miles, for shipment by railroad to the International Smelting Company's reduction plant at Tooele, Utah.

▶ Claims at South Gilbert, Esmeralda County, known formerly as the Hardscrabble gold mine, have been acquired under option from Emory Johnson, of Tonopah, by E. L. Cord and Fred A. Vollmar, Jr., who are operating the old Mary mine, at Silver Peak, and are building a 250-ton flotation mill, having bought the equipment of the lately dismantled mill of Como Mines Company.

▶ Antimony claims at four separate points in Humboldt and Pershing Counties are to be developed by the lately organized Nevada Antimony Mines, Inc., which is preparing to ship 100 tons of ore per month from its Bloody Canyon mine, on the east flank of the Humboldt range. Charles A. Green, Jr., of Lovelock, is manager.

▶ Capacity of a pilot cyanide mill built last year by the Nevada Range Mines, Inc., at the old Nevada Hills mine, in Churchill County, is to be increased at once to 150 tons per day. E. P. Jennings, manager, has an office at Fallon.

▶ New Orleans and New York men have acquired under option the Great Bend mine and adjoining claims in the Diamondfield part of the Goldfield district, owned by the Great Bend, Ltd., and have nearly completed construction of a 50-ton dry-concentrating mill unit that was perfected at New Orleans by Eugene Freeman, who is in charge.

▶ After having operated with success for two months, the new cyanide mill of the Marigold Mining Company at Unionville, Pershing County, was closed down lately because of freezing weather. The company is opening and preparing to ship from another property south of Valmy, in southeastern Humboldt County. Frank E. Horton, who developed and controls the Weepah mine, is president and manager, with headquarters at Unionville.

▶ The cyanide mill of the Desert Silver, Inc., lately completed at the Nivloc silver-gold mine, 10 miles west of Silver Peak, has been treating 200 tons of ore per day with satisfactory results. Frederick E. Gray is manager, employing 120 men. Ira B. Joralemon, pesident, said that the recent cut in the price of silver would have little immediate effect on the company, but by elimination of some marginal ore it might shorten the productive life of the mine.

▶ Properties of the Copper Canyon Mining Company, in Lander County, established a new record in 1937 for volume of gold ore shipped to smelters, mostly the product of lessees. A new main shaft is being sunk by the company and designs for a flotation mill have been approved. R. C. McCarthy, of Battle Mountain, is manager.

▶ Open cuts on Cedar Hill, at the north end of the Comstock lode, are supplying 240 tons of gold-silver ore per day for the flotation mill of the Sierra Nevada, Ltd. Arthur Blake Thomas is manager and W. C. Madge is in charge at the mine.

▶ The cyanide department of the 600-ton mill of the Getchell Mine, Inc., in eastern Humboldt County, will soon be in operation, and the oil-fueled roasting plant will then start treating sulphide ore. N. H. Getchell, of Reno, is vice-president and manager, and George Wingfield is president.

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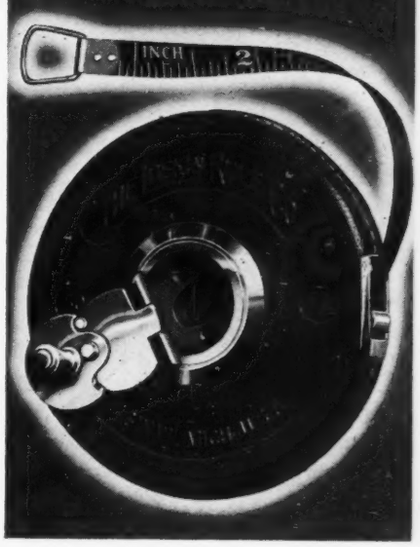

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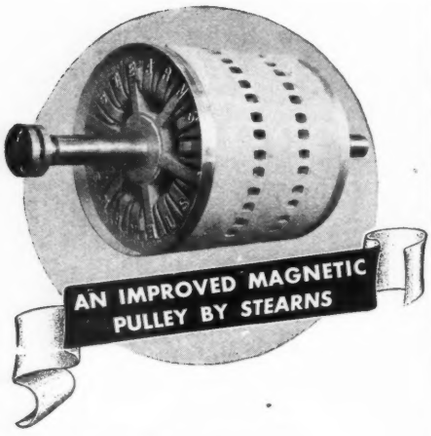

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MEXICO

Miners Watch Labor Problem in Oil Industry

Negotiations continue to seek settlement of controversy—La Estrella mine, in Sinaloa, finds high-grade ore—Boquilla Dam power strike settled

▶ Mid-winter found optimism and a deal of improvement in the Mexican mining industry. Continuance for this year by the American Government of purchases of Mexican silver and Uncle Sam's buying 35,000,000 fine ounces of old white metal that Mexico had accumulated brought much cheer to mining circles. Labor troubles, though still present, are, at this writing, less bothersome. Two promising gold strikes were made and there were some developments in various regions. President Lazaro Cardenas reiterated his assertion that his government is to advance its policy of assisting small-scale operators and prospectors to become a greater factor in the industry. The Ministry of National Economy, which has charge of mining affairs, and which is now headed by Efrian Buenrosto, who was moved up from the subsecretaryship of the Ministry of Finance, is expanding its technical services for small mining men.

▶ The industry is closely watching developments in the general petroleum situation, as the oil question, in its labor phases, has become closely related to mining. Hopes of satisfactory results are entertained in view of negotiations in behalf of the ten oil and three tanker companies involved in the general controversy that are being conducted with President Cardenas by Major J. R. Armstrong, executive of Standard Oil of New Jersey, who came to Mexico City expressly for that purpose.

▶ Production and exports of metals are holding up well. It is indicated that activities in both these fields in 1937 were far in excess of those of the previous year.

▶ Several companies have voluntarily increased their workers' wages. Some others did likewise in settlement of labor conflicts. The Federal Government intervened in some work disputes.

▶ Cia. Beneficiadora de Pachuca, S.A., M. H. Kayser, secretary, operating at Pachuca, Hidalgo, settled a labor row which threatened disruption of work by making an agreement with its staff.

▶ Preparations for exploitation along modern lines of holdings of Cia. Minera y Molinera de la Baja California, S.A., at El Alamo, Lower California, are being made by Nelson Douglass, of Los Angeles, who holds an option on the property.

▶ A flotation plant is being installed by The Bogan Mines Company, near Durango City, manager of which is A. T. Bogen.

▶ Operation of the Mercedes mine, near Cananea, Sonora, has been undertaken by David Miller, who took over the property a short time ago from Cananea Consolidated. He is arranging for several improvements at the property.

▶ Properties of Cia. Minera La Union, S. A., at Villa Felix U. Gomez, Chihuahua, have been embargoed in favor of the national miners' union, which claims 120,000 pesos (about $34,000) as compension for the workers for shutting down of the mines and for back wages.

▶ Ore containing values of about 1½ per cent tungsten and $8 gold per ton is being mined at the Pasedena property, 50 miles north of Ensenada, Lower California, by Hiram T. Horton and Fred R. Lee, of San Diego, Calif. They have installed new machinery and equipment and are employing 30 workers.

▶ Cananea Copper settled a labor dispute by reinstating four discharged employees at its workings at Cananea, Sonora, and granting the staff several economic benefits. Good gold ore is said to have been found in a strike made near Cananea's La Colorada mine. It is reported the company plans to work this deposit.

▶ High-grade ore of considerable gold value is being produced by La Estrella mine, El Tambor sector, Sinaloa, S. A. Navarro, superintendent. This mine has been worked since 1931.

▶ The strike of Jan. 26 by employees of the Cia. Agricola de Fuerza Electrica del Rio Conchos, S.A., was reported settled Feb. 3. Electric power, purchased by mining companies in the Chihuahua and Santa Eulalia districts, near Chihuahua City, and mines in the Parral, Santa Barbara-San Francisco del Oro district, was shut off and thousands of men not connected with the strike were thrown out of work. Some mining companies operated their own standby power plants, for pumping purposes.

CANADA

International Nickel to Increase Mill Capacity

Will add 5,000-ton output to present plant—Dennison Nickel plans 100-ton smelter—Value of mineral output in 1937 reached new high in British Columbia

▶ The past year has proved to be not only a record-breaker for Canadian gold mines but for nickel and other base-metal producers as well. Early in 1937 the Garson and Levack mines were opened to supplement mining operations at the Frood and Creighton mines. Robert C. Stanley, president of International Nickel Company of Canada, reports that world consumption of nickel increased 24 per cent in the first ten months of 1937, compared with the same period in the preceding year, with alloy steels absorbing more than half of the world output. No additional smelter capacity is planned at Copper Cliff for the present, but International Nickel has announced an extensive building program to increase the concentrating capacity by as much as 5,000 tons. The present daily rate of the concentrator

is 12,000 tons and for the smelter, 15,000 tons. International Nickel Company is undertaking to spend about $5,000,000 within the next two years on plant expansion which will provide for electric shoveling of the 300-ft. top layer of the Frood orebody. Very large tonnages of ore averaging better than 3 per cent in combined nickel-copper are available from this horizon and will be handled as a reserve for maintaining greater flexibility and a closer average in mining high and low grades of ore.

▶ Substantial ore reserves are reported for Dennison Nickel Mines by John C. Rogers, consulting engineer. According to the program now proposed, this property, which is in the Sudbury district, will build a 100-ton smelter which will be supplied with concentrates from an oil-flotation mill of 250 tons' daily capacity. The crushing plant will be large enough to allow doubling the size of the concentrator when conditions warrant. Last year shaft sinking was carried to a depth of 500 ft. and development work was advanced to three levels for a combined length of 1,954 ft. The shaft is to be deepened another 300 ft. and two new levels will be established. At present, 288,200 tons of ore are in sight, of which 39 per cent is to be discarded by sorting, to leave 112,398 tons having a combined content of 3.23 per cent nickel-copper.

▶ Argosy Gold Mines have run into financial difficulties and have gone into bankruptcy, with claims totaling $183,385. With a new capital set-up the property is expected to make a better showing. Located 35 miles north of J-M Consolidated, in the Patricia district, the Argosy has been handicapped by high operating costs. Last summer the Ontario Hydro Electric Commission installed a new unit at the Ear Falls dam, and the transmission-line construction is now under way for a proposed hook-up with J-M Consolidated, Argosy, and Uchi Gold Mines.

▶ Siscoe Gold Mines, pioneer producer of the great gold belt in northwestern Quebec, completed 1937 with new records for both production and earnings. Gold bullion shipped during the twelve months was worth $2,633,659, almost 10 per cent above the record for the preceding year. Recovery per ton averaged $13.16. Positive ore reserves, announced a year ago, were 451,827 tons, a figure equal to more than two years' supply for the mill. The strongest ore position in the mine's history is expected to be shown by tonnage estimates at the end of 1937. Extensive exploration has been opening up several new promising areas of potential ore which indicate that the whole mine picture will be substantially improved this year. Preparations are under way to deepen the main shaft from the present bottom at 1,900 ft. down to 2,500 ft.

▶ Stadacona Rouyn Mines was recently examined by the engineering firm of Ed. Futterer and Fraser D. Reid, whose report estimates ore, from the 150-ft. level down to the 600 level, at 154,000 tons. Allowance is made for dilution in calculating the average grade at $5.31, although a 50c. improvement may be secured if more selective mining is adopted. Millheads have averaged $5.07 per ton since first production in November, 1936. An operating profit of 85c. a ton is anticipated after the mine has been put on a more efficient basis. Although installed milling equipment can handle up to 460 tons daily, underground development at the present time is inadequate to supply more than 350 tons per day.

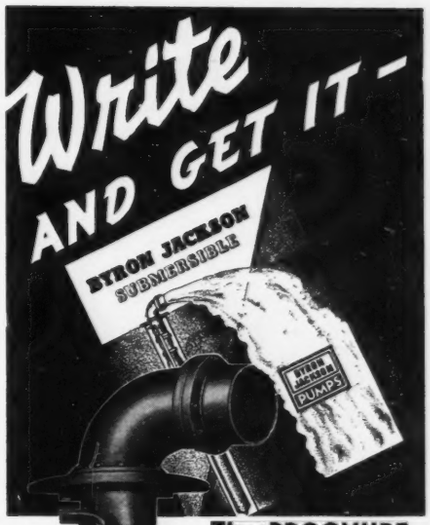
▶ Perron Gold Mines, located 15 miles east of the Siscoe, has almost doubled bullion output in 1937 compared with the previous year. The 350-ton mill went into operation in February, 1936, with gold recovery to the end of 1937 amounting to $1,505,704. An important new ore zone was recently encountered on the 600 level, according to the general manager, J. P. Norrie.

▶ McWatters Gold Mines is sinking a winze below the 400-ft. level to a depth of 900 ft. which should be completed early in April. Objective of the winze is exploration of an area discovered in diamond drilling, in line with the large orebody developed above the second level. Lateral exploration has been concentrated at a point 1,000 ft. east of the shaft, where a 3-ft. vein has returned assays of $25.00 per ton. Ore reserves are stated to be about equal to mill requirements for one year. W. J. Hosking is mine manager.

▶ At Sullivan Consolidated Mines, adjoining Siscoe on the east, plans are being made to increase mill capacity above the present daily rate of 150 tons, following a substantial increase in ore reserves. Underground work has not yet gone deeper than 500 ft., but drilling to the 1,000-ft. horizon has confirmed the downward continuation of the ore.

▶ With a gain of 15 per cent in earnings for 1937, Macassa Mines completed a year of general mine improvement. Three levels below the 3,000 were the source of most of the material put through the 275-ton mill, and ore possibilities there will allow for much future expansion. The internal shaft reaching from 3,000 to 3,375 ft. is being continued to a depth of 3,750 ft. to open up a block of three new levels. As a result of the year's efforts, ore reserves now stand well above estimates at the end of 1936. Total bullion output for 1937 was $1,464,556 from ore having an average recovery of $16.16.

▶ The mining industry of British Columbia reached a new peak in 1937, when minerals to the value of $73,176,315 were produced, an increase of 35 per cent over the figures for 1936. The previous peak was $68,245,000, established in 1929. Records for all time were made last year in the volume and value of the gold, lead and zinc produced, and in the volume of silver. The value of the lead output, $21,393,240, was the greatest for any one mineral in any single year. Zinc production was $14,400,120, and gold, $17,889,000, including both lode and placer output. The gold mining industry is in a more sound position than ever before; in excess of thirty lode mines were in production on a substantial scale last year, and it is expected six more properties will soon be equipped with concentration plants.



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▶CANADA

▶Production of refined antimony in Canada will soon be commenced by the Consolidated Mining & Smelting Company at Trail, B. C. The new refinery will treat 10 tons of flue dust residue per day from the silver plant, and it is expected 1,400 tons of metal will be produced annually. This is more than twice the quantity consumed in the Dominion each year.

▶At the Cariboo Hudson, about 20 miles southeast of Wells, ore carrying 0.5 oz. gold per ton has been opened in the Shasta vein, 800 ft. beyond the Hudson vein. Consideration is being given to the construction of a 100-ton mill instead of the 50-ton plant first proposed. Fred M. Wells is managing director, and R. J. Spry, consulting metallurgist, has been retained to design the mill. Additional diesel power is to be provided as soon as possible to facilitate development work.

▶A more adequate power plant is being installed at the Privateer mine, situated in British Columbia's new gold camp at Zeballos, and it is expected that production of crude ore will soon be increased to $25,000 a month. A wharf is to be built at Zeballos Arm, and the road into the Goldfield and other properties will be completed soon.

▶Gold to the value of approximately $2,908,000 was produced in 1937 at the Bralorne mine, Bridge River district, the largest producer in British Columbia. There was an increase of about $675,000 over the previous year's output, due largely to an improvement in the grade of mill feed from an average of $13.64 in 1936 to $16.85 in 1937. R. Bosustow is managing director.

▶The Pioneer mine produced bullion valued at about $2,150,000 in 1937, as compared with $2,435,000 in 1936. Gross profit is estimated at $1,198,000 as against $1,541,000 in the preceding year. The decrease in earnings is attributed to the lower grade of ore mined and a rise in costs partly attributable to the depth now attained by the workings.

▶Production at the Minto mine, Bridge River district, has been suspended until more funds can be raised for development work. A. G. Larson is the engineer in charge.

▶The new 125-ton cyanidation plant at the Dividend mine of Osoyoos Mines, Ltd., Osoyoos, B. C., commenced operations in December. J. O. Howells is general manager.

▶The downward continuation of the main vein at the Ymir Yankee Girl gold mine is being developed with good results at the 1,550 level, where ore carrying 0.5 oz. gold has been opened across a width of from 5 to 9 ft., according to word received by R. B. Lamb, managing director, from B. W. W. McDougall, the company's consultant.

▶Milling capacity at the Cariboo Gold Quartz is to be increased shortly from 250 to 275 tons per day, according to the managing director, R. R. Rose.

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AUSTRALIA

Mount Isa Reports First Profit Since 1931

Output greater but costs rise and ore reserves decline during year—Mine development at Lake View & Star, Ltd., reveals promising vein

▶Mount Isa Mines, Ltd., Mount Isa, N. Q., showed a profit for the year ended June 30 of £70,309, after providing for all charges except depreciation. This is the first profit since operations began in 1931 and reduces the accumulated loss to £348,534. Production figures compared with last year were:

	Silver, Ozs.	Lead, Tons	Zinc Concs. Tons
1935/6	2,734,109	34,331	46,839
1936/7	3,123,626	36,824	52,204

Costs rose sharply from 22/7 to 29/6 per ton of ore, due to greater expense of mining at greater depth, increased development and higher wages. The Industrial Court of Queensland has awarded the employees of the company a "prosperity bonus" of 6d. per shift for every £1 rise in the price of lead above £20 Australian, with a maximum of £31 Australian. This is similar in principle to the bonus in force at Broken Hill for the last two years, which however, commences at a lower lead price (£16 Australian). Ore reserves at June 30 are set down at 13,000,000 tons assaying 8.3 per cent Pb, 9.1 per cent Zn, and 5.5 oz. Ag per ton, a recession of 430,000 tons on last year's figures.

▶Australian gold yield for the nine months to Sept. 30 was 993,146 fine ounces, as compared with 842,179 fine ounces for the same period last year.

▶It is reported that the Federal Government is communicating with the West Australian and Queensland Governments with a view to arranging for the continuance of the North Australian Aerial Geological and Geophysical Survey for another two years. The work was begun in 1934 and the original funds will be exhausted early in 1938. The abandonment of the project at this stage would, it is felt by the Government, be most undesirable, as it considers that the results are likely to prove very helpful in the development of Northern Australia.

▶Lake View & Star, Ltd., premier gold mine of Australia, announces ore reserves as at June 30 last of 3,414,600 tons of an average grade of 5.7 dwt. per ton. As compared with last year the tonnage is up 217,000 but grade down 0.2 dwt., the increase in reserves reckoned in ounces of gold being 28,900. An important development during the year was the opening up, in the Chaffers section, of the east lode for a length of 221 ft. with average values of 8.9 dwt. per ton over 54 in. The lode is as yet undeveloped both below and above this level.

▶Triton Gold, Cue, W. A., has declared its fourth dividend of 6d., payable on Dec. 17. The company has just struck its main lode at the No. 7 (800 ft.) level. Where struck, the lode was 18 ft. wide but assayed only 4.75 dwts. per ton. However, values are expected to improve on driving south, as the point of intersection is close to the northern limit of payable ore in the lode.

▶South New Moon, N. L., is working on a large spur formation on the 580 ft. level of its mine at Bendigo (Vic.), where a width of 50 ft. is being stoped. Recent returns have been 6¼ dwt. per ton, a grade which is very profitable with costs totaling 23/9 or 2.75 dwt. A considerable tonnage of 6-dwt. ore has been developed and prospects are considered good, as there is a large area of virgin ground yet to be explored. Mill capacity is to be increased from 20 to 30 head of stamps.

▶Prospecting at Broken Hill on leases outside the areas controlled by the present operating companies is again attracting attention. After passing through 46 ft. of carbonate ore, the No. 3 bore of Silver Peak, Ltd., was continued in low grade to barren lode formation for another 35 ft., where a galena formation 3 ft. thick was passed through. Willyama Mining Pty., Ltd., a subsidiary of the three large companies, has taken a twelve months' option over the leases of Barrier Development at Piesse's Knob, 7 miles north

of Broken Hill, where diamond drilling earlier in the year gave encouraging results. Further drilling is proposed, and if results then warrant it a company will be formed to work the areas.

▶ Lake George Mining Corporation, Captain's Flat, N.S.W., aims to reach production at the rate of 15,000 tons of ore monthly by the end of 1938, but already has encountered difficulties in the prospective delivery of equipment which make it likely that this estimate may not be realized. Preliminary mine development work is well in hand.

▶ Zeehan Tin Development, Zeehan, Tasmania, reports further progress in the development of its orebodies. which are opening up satisfactorily. Erection of the pilot mill is completed.

▶ A new discovery of silver-lead ore is reported from the Zeehan district, Tasmania. A lode formation 12 ft. wide carrying payable galena has been uncovered.

▶ Magnet Silver Lead, Magnet, Tasmania, is making good progress with rehabilitation of its mine and plant. Repairs to the main shaft have been completed and the shaft has been re-equipped. Plant equipment is well advanced.

AFRICA

Ashanti Goldfields Finds Good Ore on Deepest Level

Recent development assures ample ore reserves—Marlu Gold Mining Areas increasing mill capacity—Tano Gold Dredging shareholders advised to seek settlement with Anglo-Oriental and General Investment Trust

▶ The future of Ashanti Goldfields has been made increasingly secure by a remarkable development on its deepest level, the 29th, a crosscut showing the reef to assay 81 dwt. over a width of 12 ft. In December Ashanti recovered 18,568 oz. of gold from the treatment of 18,250 tons of ore, and its net profit after all allowances was £82,267, against £80,444 in November.

▶ Another Gold Coast company, Marlu Gold Mining Areas, reports a net profit of £49,498 for December, a new high record. Marlu recently declared its maiden dividend. A fourth unit is being added to its reduction plant.

▶ The directors of Tano Gold Dredging have advised the shareholders to settle any claim they may have—due to the property having failed to contain the values claimed in the reports presented when it was purchased—with or against the Anglo-Oriental and General Investment Trust. It seems that Tano Alluvials, the vendor company, received 300,000 full-paid shares of Tano Gold Dredging and paid them over to Anglo-Oriental. The aim is to have the latter adjudged the promoter, as it is claimed that nothing can be recovered from either Tano Alluvials or from individuals. The portion of the property being worked, the richer area, is yielding small profits.

▶ Loangwa Concessions (Northern Rhodesia), Ltd., has been placed in voluntary liquidation, all of its share capital having been acquired by Rhodesian Anglo American. The latter will carry out the prospecting contracts under which the former acquired its concessions and will come into the possession of its considerable assets. Though most of the more promising area of the concessions has been explored and prospected without anything of importance being discovered, there are possibilities in the remaining areas. The greatest of these possibilities is that the stage has been reached when nothing further is expected to be discovered.

▶ Konongo Gold Mines, of which Robert Annan is chairman. treated 7,091 tons of ore in December and recovered 3,188 oz. of gold. This Gold Coast property is continuing to develop favorably, and as it has reserves of nearly 300,000 tons averaging about 9.9 dwt. per ton, an increase of plant capacity is in prospect.

▶ British South Africa Company ("Chartered Company") has declared a dividend of 1s. and a bonus of 1s. per share. This doubles the bonus paid a year ago. The improvement in copper, coal, and business generally has added substantially to "Chartered" income. It is receiving increased royalties, dividends on its considerable holdings of Rhodesian copper shares, and its railways are doing a record business.

▶ The first of the 1937 gold mining records has been revealed by the Transvaal Chamber of Mines. Last year's production, 11,740,891 fine ounces. was 405,800 oz. more than the 1936 output, and exceeds by nearly 200,000 oz. the record output of 1932. The new record is the more noticeable as it has been established against a record low grade and a declining native labor force. However, the mines have been able to send so much ore through the mills that the final figures to be published towards the end of the month will also show a record tonnage. The following table shows the total gold output from all sources of the Transvaal Province since 1931:

Year	Total Go'd Output, Ounces	Increase + or Decrease — Over Previous Year, Ounces
1931	10,877,707	
1932	11,557,858	+ 670,151
1933	11,012,339	— 545,519
1934	10,479,193	— 533,146
1935	10,773,041	+ 294,858
1936	11,335,091	+ 562,050
1937	11,740,891	+ 405,800

When South Africa left the gold standard at the end of 1932, the mines considerably reduced the average grade of ore milled. Although the tonnage was immediately increased, this was not sufficient to prevent an appreciable drop in the yield. When the tonnage milled reached 43,746,000 tons in 1935, this proved sufficient to reverse the downward trend of the yield. Since 1935 both tonnage and yield have increased every year, and the final figures for 1937 will show a record tonnage of about 50,000,000.

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FIJI ISLANDS

Gold Ore Found in Prospect On Koroere Hill

Shaft sinking and drifting will continue to determine merits of deposit — Emperor Gold starts new mill

▶ Koroere Gold, Tavua, Fiji, reports having commenced prospecting operations at the north end of the lease, near the Emperor-Koroere boundary, where preliminary trenching has disclosed a fairly regular formation running south on the western slope of Koroere Hill. A shaft being sunk at a point 400 ft. south of the boundary has disclosed lode formation of soft altered andesite carrying thin leaders of hard stone. Values to 21 ft. have varied from a trace up to 21 dwt. Sinking will be continued while values persist, and later crosscuts will be put out to test the extent of the formation.

▶ The new mill of Emperor Gold Mines, Ltd., Tavua, Fiji, started operations early in January. The plant, which is of 12,000 tons' monthly capacity, is designed for the cyanidation treatment of oxidized ores, of which over 440,000 tons have been proved. At a later date, when semi-oxidized and sulphide ores have to be treated, it is likely that a flotation section will be added.

NEW GUINEA

Placer and Lode Mines Maintain Steady Output

New Guinea Goldfields producing about 2,000 oz. gold per month—Roads needed for further prospecting and development

▶ Enterprise of New Guinea is making a moderate profit from its hydraulic gold operations in the Surprise Creek area, but is finding developments at its Edie Mine hampered by lack of road transport facilities from the coast. However, developments are satisfactory, although not sufficiently advanced to give an accurate estimate of tonnage. Grade is at present averaging 6 dwt.

▶ Net profit of New Guinea Goldfields, which carries out both lode and alluvial operations in New Guinea, was £88,742 for the year ended Sept. 30. Present rate of production is 2,000 oz. gold and 4,000 oz. silver monthly from lode mining operations at Edie Creek and Golden Ridges Mines, plus 1,250 oz. gold and 900 oz. silver per month from alluvial workings. Ore reserves are estimated at 148,000 tons of proved and probable ore averaging 10 dwt. gold and 10.4 oz. silver per ton, but do not include any ore in the deeper levels, as the known supplies are sufficient to provide for mill requirements for two years and it is considered uneconomic to proceed with opening up of orebodies too far in advance. Alluvial resources of the Koranga or Wau area are estimated at 9,600,000 cu.yd., averaging 12½d. per cubic yard.

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Drilling With Detachable Bits—III

PART II of this article, published last month, completed the description of the practice with detachable bits and regular drill steel at "Western Mine No. 1" that was begun in the November, 1937, issue also that of the United Verde Extension mine, at Jerome, Ariz., and took up the drilling practice at "Western Mine No. 2." The paper is continued in this and the following pages:

The following sections of drill steel are in service: For drifters, 1¼-in. hollow lugged round; for stopers, 1-in. hollow quarter-octagon with plain shanks; and for jackhammers, both ⅞-in. hollow, collared, hexagon and 1-in. hollow, collared, quarter-octagon. All of these steels contain 0.95 per cent carbon.

The steel-sharpening shop is in the mine yard near the portal of the supply adit. Equipment comprises two machine sharpeners with punches, two single-opening oil-burning furnaces, one air hammer, one bolt machine, one drill press, one single emery wheel, one double emery wheel, one forge, three anvils, one bench vise, and two quenching tanks.

On the regular steel the conventional bits have an angle of 90 deg. between the cutting faces and double clearance tapers of 5 and 14 deg. The gage of the starters is 2 3/16 in. and of finishers is 1 11/16 in. Jackhammer starters less than 4 ft. in length have a gage of 1 13/16 in. The gage change is ⅛ in.

With conventional bits on regular steel, the feet drilled per machine shift in raises is 68, and in shafts, 72. Using regular steel with jackhammers and stopers, the feet drilled per bit dulled in shafts, raises, and stopes varies from 2½ to 16 and averages 6.53. The average depth of hole drilled is 5 to 6 ft. Estimated feet of hole drilled per month is 80,000. Loss of steel from all causes is 0.24 lb. per bit sharpened, or 0.036 lb. per foot of hole drilled.

Conventional bits are forged at an estimated temperature of 1,900 to 2,000 deg. F. Three heats are generally required for fabricating new bits and one heat is needed for resharpening them. For hardening, the bits are heated to a cherry red, or about 1,400 deg. F., and are quenched in water to which some potassium cyanide has been added. The quenching tank is emptied and cleaned once each three months. Approximately 600 pieces of steel per day are sharpened and hardened by four men.

In forging shanks, two heats at a temperature of 1,900 to 2,000 deg. F. are generally required. The steel is allowed to cool in air. On the following day the steel is normalized by heating slowly to about 1,400 deg. F. After one hour at this temperature, it is set in a rack to cool in air. The shanks are hardened by heating the ends to 1,400 deg. F. through a distance of 1 in. and by quenching in oil until cold. They are then placed in a rack to drain.

The steel is transported in cars, which are pushed on and off the cage at the shaft and are run throughout the various levels as required. Air hoists are installed at raises for handling the steel, which is loaded in wooden buckets 14 in. square and 24 in. high.

The figures in Table IV, based on estimated footages, show the average cost per bit dulled and the average cost per foot drilled in stopes, raises, and shafts in connection with stopers and jackhammers using regular steel with conventional bits.

Detachable Bits—These are used exclusively in driving drifts. Because large mounted machines are employed on this work and because all other drilling throughout the mine is done with smaller machines using regular steel and conventional bits, there is no common basis for a detailed comparison of results from the two systems. The estimated footage drilled per month with detachable bits is 13,000.

Since acquiring the original stock of detachable bits, all new bits purchased have been 2¼-in. gage. Detachable bits are not reground at the mine but are sent to a custom machine shop some 60 miles distant. A flat rate of 10c. per bit is charged for sharpening. Bits are not ground to a definite gage but are first sharpened and then sorted into lots that have following gages with a maximum differential of ¼ in.

There is an average of 1.38 regrinds or 2.38 uses per bit purchased. The average feet drilled per bit dulled is 14.84, and the feet drilled per bit purchased is 35.3. The gage loss is 3/32 to ⅛ in. per bit dulled.

Rods are reconditioned at the company shops. Shanks are forged by exactly the same methods as employed for regular steel. The thread end is upset at the drill-sharpening shop and annealed in lime. The shoulder is turned and threads are rough cut on a lathe. Then the threads are finished on hand dies. Hardening is accomplished by heating the entire length of the threaded portion to a slightly lower temperature than for hardening shanks, and by quenching in oil until cold.

The distance drilled per rod broken, based on a record of six rods, averaged 328 ft. On the basis of the number of times used, the breakage of the rods was 0.77 per cent.

Bit carriers are simple loops of wire onto which the bits are strung. Bits are exchanged by the miners at the warehouse on the surface. The loss of bits from all causes for a recent six-month period was 1.7 per cent.

An interesting experiment for adapting detachable bits to hand-rotated stopers is now in progress.

Table IV—Operating Costs for Drilling in Stopes, Raises, and Shafts With Conventional Steel(a)
Western Mine No. 2

	Cost per bit dulled	Cost per foot drilled	Accumulative cost per foot drilled
Reconditioning drill steel, total	$0.0839	$0.0129	$0.0129
Labor	0.0428		
Steel replacement	0.0411		
General shop expense, total	0.0201	0.0031	0.0160
Compressed air	0.0127		
Fuel oil and gas	0.0030		
Supplies	0.0044		
Transportation of drill steel, total	0.1461	0.0223	0.0383
Through haulage adit	0.0020		
Underground distribution and collection	0.0198		
Hoisting	0.0374		
Miners, toplanders, and raise hoistmen	0.0869		
Operating machine drills	1.2965	0.1985	0.2368
Labor	0.9042		
Compressed air	0.1492		
Machine drill repairs	0.1438		
Air lines	0.0520		
Water lines	0.0473		
Total operating exclusive of supervision	1.5466	0.2368	0.2368

(a) Based on studies made by Paul T. Allsman, assistant mining engineer, U. S. Bureau of Mines, in June 1936.

By making a ratchet an integral part of the fronthead on the stoper, rotation of the drill steel is confined to one direction. Though the device seems to have possibilities for this particular field, it is still in the development stage and its operation has not been sufficiently extensive to permit forming final conclusions.

Table V, based on estimated footages, shows the operating costs for drilling in drills with a drifter having a cylinder 3½ in. in diameter and using detachable bits.

Table V—Operating Costs for Drilling in Drifts With Detachable Bits(a). Western Mine No. 2

	Cost per Bit Dulled	Cost per Foot Drilled	Accumulative Cost per Foot Drilled
Bits, total	$0.1727	$0.0116	$0.0116
New bits (at 27.3c. each) 2.38 uses	0.1147		
Regrinding bits (outside contract at 10c. each)	0.0580		
Rods, total	0.0158	0.0011	0.0127
Labor, fabricating and reconditioning	0.0070		
Steel replacement	0.0088		
General shop expense (compressed air, fuel oil, gas, supplies), total	0.0016	0.0001	0.0128
Transportation of rods, total	0.0026	0.0002	0.0130
Through haulage adit	0.0001		
Underground distribution	0.0009		
Hoisting	0.0016		
Operating machine drills, total	1.7454	0.1176	0.1306
Labor	1.3120		
Compressed air	0.1648		
Machine drill repairs	0.1589		
Air lines	0.0574		
Water lines	0.0523		
Total operating, exclusive of supervision	1.9381	0.1306	0.1306

(a) Based on studies made by Paul T. Allsman, assistant mining engineer, U. S. Bureau of Mines, in June 1936.

The Hillside Mine, Hillside Mines, Inc., Hillside, Ariz.

Summary—Inasmuch as detachable bits are used exclusively, no operating statistics are available for comparison with statistics on conventional bits on regular drill steel. One of the advantages of the detachable bit at this mine is the small cost of nipping, and another is the elimination of all forging and hardening of bits and shanks at the mine shop.

Rocks Drilled—The principal rocks drilled are schist with quartz lenses and ore. These are seamy and may be either soft or hard and abrasive.

Operating Practice—Two kinds of rock drills are used; namely, jackhammers with 3½-in. diameter, which are also mounted for use as drifters; and 2⅝-in.-diameter stopers equipped with automatic rotation. The hammer in each machine strikes the shank of the drill steel direct, without any intervening anvil block. There is one man per drill, except in hard ground, where the operator has a helper. The air pressure is 90 lb. per square inch at the compressor.

All drilling is done with detachable bits. Sixty to eighty feet is drilled per machine shift. Drill holes average 5 ft. deep. Footage per bit dulled is 15 to 20 ft.

The drill-sharpening shop is located at the portal of the adit. The equipment consists of one bit-grinding machine of standard make, a blacksmith's forge, and anvil. Sections of steel in use are hexagon, quarter-octagon, and round, all of which are 1 in. in diameter. The shanks on each section are lugged, so that there is in reality one universal class of drill steel at this property.

Life of rods was reported as satisfactory. When a shipment of broken rods has accumulated, they are transported by truck and rail to a custom conversion shop 77 miles distant.

Bits are the standard four point design with an angle of 90 deg. between cutting faces. The blacksmith grinds the bits as a part of his routine when not engaged on other work. Miners exchange bits at the shop. New bits purchased are either 2 in. or 1¾ in. in diameter. They have two regrinds, or three uses. The life of a bit is 45 to 60 ft. Bits are discarded at 1½-in. gage. Bits are not rehardened. The length of run is 1 ft. for hard ground and 2 ft. for soft ground.

Western Mine No. 3

Summary—Use of detachable bits has been limited to long-hole drilling with Leyner steel in open-pit operations. This is because the economy in the use of detachable bits is due largely to the cost of steel transportation and nipping, which are at the maximum for regular steel when drilling long holes. The drilling speed of detachable bits exceeds that of conventional bits by 17.5 per cent. In hard ground, on account of excessive abrasion in drilling which limits resharpening to one regrind, it has been found profitable at this mine to reforge and reharden detachable bits after each use.

Rocks Drilled—The principal rocks drilled are schist, porphyry, diorite, siliceous sulphide, massive sulphides, and sulphide ore. These present a wide range of drilling conditions, because they may be hard, abrasive, fitchery, shattered, seamy, or soft.

Operating Practice—At this mine the sizes of the machine drills are as follows: jackhammers, 2½ in.; sinkers and drifters, 3½ in:; stopers, 3 in.; and wagon drills, 3½ in. There is one operator per drill for jackhammers and sinkers; for the drifters and wagon drills there is an operator and a helper. With mounted drills in underground mining the miner is given help only when setting up his machine. Air pressure is 100 lb. at the compressor and about 85 lb. at the drill. With conventional bits on regular drill steel, the footage drilled per machine shift with wagon drills is 50 ft. when drilling 20-ft. holes. All drilling is wet.

The steel-sharpening shop is near the portal of the supply adit. A special truck with a horizontal box divided into four compartments is provided for transporting drill steel underground. For delivery on the surface, both track busses and auto trucks are used. All steel is sorted at the shop according to its length. The steel in service is 1¼-in. hollow lugged round for drifters and wagon drills; 1-in. hollow quarter-octagon for stopers; ⅞-in. hollow collared hexagon for jackhammers, and ⅞-in. hollow quarter-octagon for pluggers.

The shop equipment is as follows: one shanking machine; eight machine-sharpeners, including two spares; eight punching machines; thirteen oil furnaces using 1¼-lb. air pressure; eleven pyrometers; one electric furnace; two automatic heat-treating machines; two circular, turnable-type, steel racks; two double emery wheels; and one detachable bit grinder. Machines are installed on each side of a central track. The floor areas adjacent to the side walls of the shop are laid with steel plates. This arrangement permits the use of trucks with flanged steel wheels. The oil quenching tank is water-jacketed on the sides by means of 160 ft. of 1¼-in. pipe.

Regular Steel—The full capacity of the shop is 2,500 pieces of regular drill steel per shift. One sharpener with a helper sharpens 375 to 400 Leyner bits per shift, or 450 to 500 jackhammer bits. About 100 pieces of steel per day are sharpened for each man in the shop.

For regular steel, the forging temperature as indicated by pyrometers on oil furnaces is 2,000 deg. F. The hardening heat is 1,425 to 1,430 deg. F. Bits are quenched in cold water. The Brinell hardness of finished bits is 550 to 600.

Shanks are forged and hardened as described hereafter in the discussion on detachable bits.

(*To be continued*)

—Excerpted from United States Bureau of Mines Information Circular No. 6951, written by McHenry Mosier. Previous published circulars on the same subject by the same author are I.C. 6877, 6911, and 6936.